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ARTICLE I.

An Account of three different Kinds of Timber-Trees, which are likely to prove a great Acquisition to this Kingdom, both in point of Profit and as Trees for Ornament and Shade. By CHARLES WHITE, *Esq. F.R.S.* *

IN making a collection of such hardy trees and shrubs as would grow and even flourish in the open air, at Sale, in the county of Chester, I soon observed that there were three forest trees, of different genera, which grew much faster than the others in the same soil and situation, viz. the Black American Birch with broad leaves, the Athenian Poplar, and the Iron Oak with prickly cups.

The Broad leaved American Black Birch, Betula nigra Linn. Spec. Plant. 1394, is described by Mr. Aiton in his Hortus Kewensis: *B. foliis rhombeo-ovatis, duplicato-serratis, acutis, subtus pubescentibus, basi integris; strobilorum squamis villosis; laciniis linearibus, æqualibus.* It is a native of Virginia and Canada, and was first introduced into England (where it grows in the greatest luxuriancy, and perfects its seeds) by Peter Collinson, Esq. in the year 1736. There is no doubt, therefore, that it will soon become very plentiful and cheap. It is very desirable in pleasure-grounds, as it is the first forest tree in the spring which presents us with its leaves; these are of a light and lively green. Its bark, which is white, makes at all times a beautiful variety when intermixed with other trees. It is said to be the most useful timber tree in North America for building both of houses and boats, and will grow fast in any soil or situation, whether wet or dry.

* Manchester Memoirs, vol. v. part 1.

Miller,

Miller, ſpeaking of trees of this deſcription, ſays " that they may be propagated by ſeeds, in the ſame manner as the common birch-tree, and are equally hardy. Some of the trees now begin to produce their catkins in England, ſo that we may hope to have plenty of their ſeeds of our own growth, for at preſent we are ſupplied with them from America. As theſe grow more vigorouſly than the common ſort, and thrive on the moſt barren ground, they may be cultivated to great advantage in England; for their wood is much eſteemed in Canada, where the trees grow to a large ſize: and they are by no means an unſightly tree in parks; for their ſtems are ſtraight, the bark ſmooth, and their leaves are much larger than thoſe of the common birch; ſo may be planted in ſuch places where few other trees will thrive."

Mr. Hanbury ſays: " The black Virginian birch, being of foreign growth, is propagated for wilderneſs and ornamental plantations; but as it begins now to become pretty common, it is to be hoped it will ſoon make a figure among our foreſt trees, it being equally hardy with our common birch, and will arrive at a much greater magnitude. This ſpecies will grow to be upwards of ſixty feet in height. The branches are ſpotted, and more ſparingly ſet on the trees than the common ſorts. The leaves are broader, grow on long footſtalks, and add a dignity to the appearance of the tree; and as it is naturally of upright and ſwift growth, and arrives at ſo great a magnitude in few years, prudence will direct us to let it have a ſhare among our foreſt trees, to plant them for ſtandards in open places, as well as to let them join with other trees of their own growth, in plantations more immediately deſigned for relaxation and pleaſure." I planted one of theſe trees nineteen years ago, and it is now forty-five feet ſix inches in height, and three feet ſeven inches in the girth.

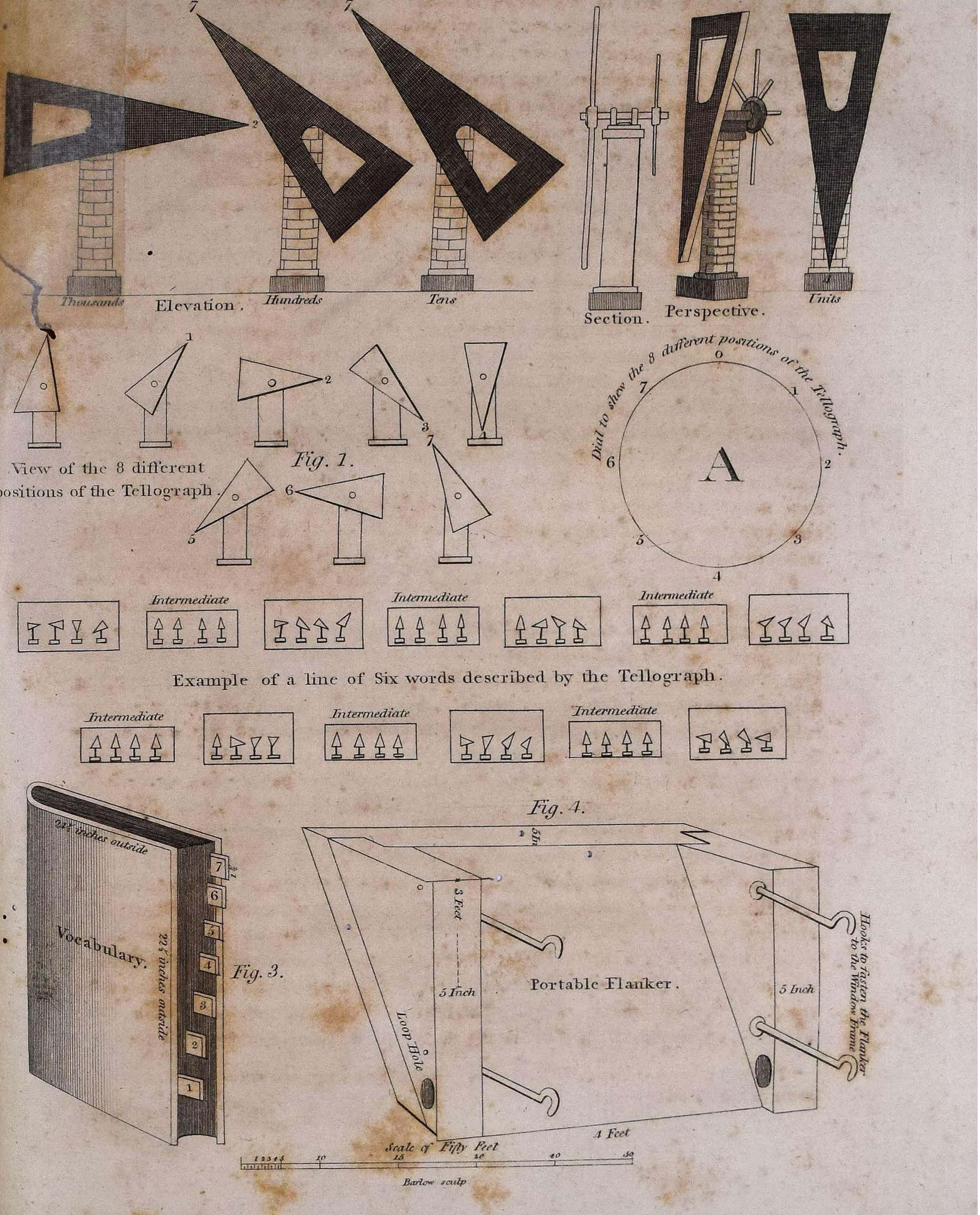
The Athenian Poplar Tree, Populus (Græca) foliis cordatis, glabris, baſi glanduloſis, remote crenatis; petiolis compreſſis; ramis teretibus. The Athenian poplar is a native of the iſlands of the Archipelago, and was firſt cultivated in England by Hugh duke of Northumberland in the year 1779. Perhaps there is no deciduous tree ſo beautiful, or ſo proper for pleaſure-grounds intended for ornament and ſhade, as this poplar; having a fine upright ſtem; the branches well diſpoſed; the bark ſmooth, and of a ſilvery hue, reſembling ſatin-wood. The leaves, which are of a light green, are produced very early in the ſpring, and are retained on the tree longer than on any deciduous tree in this country, not falling off till late in the autumn: they are never blighted nor infeſted with inſects, nor does it loſe a leaf during the whole ſummer. Though the poplar is generally termed an aquatic, this will grow in any ſoil or ſituation; and is of quicker growth in dry upland than any tree we are acquainted with in this climate, though not quite of ſuch quick growth as the Huntingdonſhire willow in rich moiſt meadow land. In ſuch a ſituation, I have fallen a Huntingdonſhire willow*, from which I made a ſtaircaſe when it was only of nineteen years growth, from a cutting. The Athenian poplar is propagated with the greateſt advantage by ſuckers and layers; but it is with great difficulty raiſed from cuttings or truncheons. The common way of raiſing them, amongſt the nurſerymen, is, by engrafting them on ſome other poplar: but the trees thus raiſed are of little value, being very ſlow in their growth; and it is owing to this circumſtance, perhaps, that their real

* I cannot find that this ſpecies of willow has been deſcribed by any botanical writer; but it is well known among the nurſerymen by this name.

worth

Art of conveying Intelligence.

Philos. Journal Vol. II. Pl. XIII. facing p. 334.



Portable Tellograph.

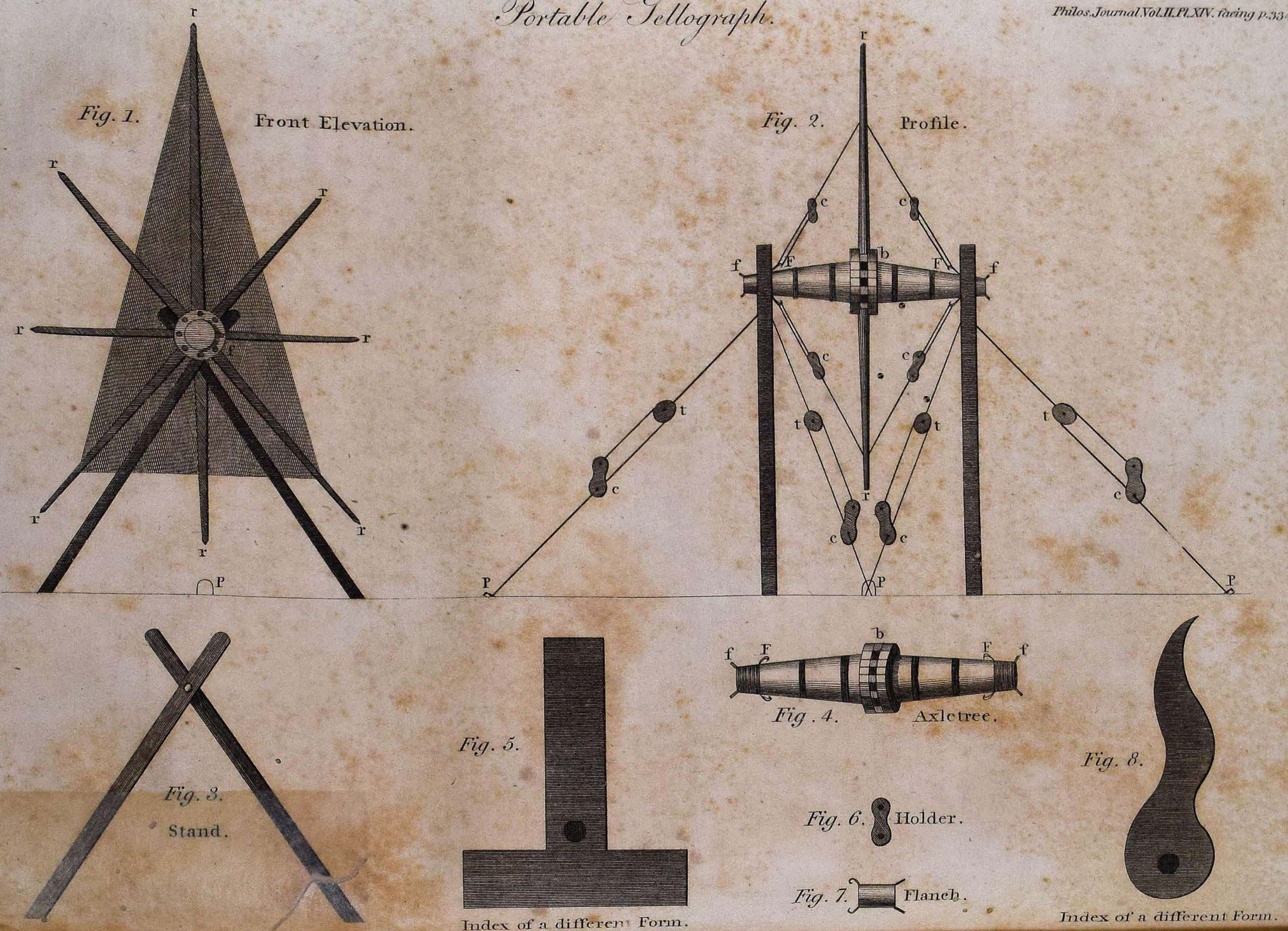


Fig. 1. Front Elevation.

Fig. 2. Profile.

Fig. 3. Stand.

Fig. 4. Axletree.

Fig. 5. Index of a different Form.

Fig. 6. Holder.

Fig. 7. Flanch.

Fig. 8. Index of a different Form.

worth has not before been discovered. About twelve years ago I purchased two plants of this poplar, from two different nurserymen in London, at one guinea each; one of them was grafted upon a different kind of poplar, the other was upon its own roots. I placed them near together, in a dry situation, in a light soil, underneath which was a stratum of gravel. The grafted one made very little progress; I therefore converted it into a stool, and raised several plants from it. The other, which is upon its own roots, has made a rapid progress, being at least fifty-one feet high, and two feet nine inches in the girth. It produces annually a great number of suckers, with which I have supplied many of my friends*.

The third is *The Iron, Wainscot,* or *Turkey Oak,* so called by Mr. Luccomb. I have long been in doubt what species of oak this really was; but one of mine having borne some acorns this year, has ascertained it to be a variety of the *quercus cerris;* and it appears to me to be either a *nondescript,* or what Mr. Aiton, in his Hortus Kewensis, calls *frondosa: foliis ovato-oblongis, leviter sinuatis, planiusculis:* commonly, Turkey oak tree. It is what Mr. Luccomb generally grafts his Luccomb oaks upon; and the plants certainly grow faster when grafted upon this oak than upon any other. About twenty years ago, in making a collection of oaks, I received several from Mr. Luccomb, both of the iron and the Luccomb oak; but I soon found that the iron oak overgrew all the others, and was equally ornamental as the English oak. From a branch which I have sawed off, the wood appears to be as hard and as ponderous as the English oak.

The following is an account of the size and age of some Iron, Luccomb, and English Oaks, growing in my collection at Sale:

	Height.		Girth.	
	Feet.	Inches.	Feet.	Inches.
An iron oak, 20 years old	36	0	3	3
Another, of the same age	37	0	3	0
A Luccomb oak, of the same age, grafted on an English oak	32	2	2	5
An English oak, of the same age	28	0	2	6
Another, 40 years old	39	0	2	10
Another, 56 years old	54	0	3	4

The following is a Copy of a Letter from Mr. Luccomb to Mr. Babington, dated Newbridge, Exeter, September 17, 1795:

"All I can say of them (the iron oaks) is, that my father had a few of them as a present from William Ball, Esq. of Manhead-house (now lord Lesburne's, near Chudleigh, Devonshire), about fifty years since, by the name of the iron or wainscot oak, which Mr. Ball received from Turkey by one of his own ships trading there. They are the same sort which you have noticed at Hillersdon, as my father sold some of them to Mr. Creroy about forty years since. They have, as you observe, a very jagged leaf, and the cup of the acorn is rough like a bur. They are not evergreen."

* There is another poplar of very swift growth, which makes a very handsome tree, and will flourish in any situation or soil. It is the *Populus cordifolia canadensis,* or Berry-bearing Poplar, as it is commonly called. This tree will grow freely from cuttings.

The following is a Letter I received from my worthy friend the Rev. Thomas Gisborne, author of several useful publications:

"DEAR SIR,

"Yoxall Lodge, Oct. 20, 1795.

"I have this evening received a letter from my brother-in-law, Mr. Babington, respecting the measurements of the iron oaks at Hillersdon, near Cullompton, where he now is: I subjoin what he says on the subject, and have pleasure in finding the result so honourable to the tree which you recommend.

"I am, Sir, &c.

"THOMAS GISBORNE.

"——To-day I have measured some of the oaks about three feet and a half from the ground; and give you the result, which I thought would be fair and satisfactory, in the following way:——

"No. of English oaks.	Circumference. Feet.	Inches.
8	31	1
9	30	1
9	32	8
26	26) 93	10
Average circumference	3	$7\frac{1}{2}$

"No. of iron oaks.	Circumference. Feet.	Inches.
6	31	6
6	32	10
6	31	9
18	18) 96	1
Average circumference	5	4

"As circles are as the squares of their circumferences, pieces of the buts, at this height, a foot long, would be to each other as 1877 : 4096. Now, supposing the iron oaks to carry their buts as much higher than the others as their substance below would lead us to expect (and they seem, in fact, to do this or more), there must be four or five times as much wood in them as there is in the English oaks. An old labourer here informs me, that all were planted at the same time, between forty and fifty years since. They stand in rows, ten feet asunder, and the trees are twenty feet from each other in each row. I measured such trees as first presented themselves, with the exception of one or two which seemed unhealthy. They are on a steep bank and a gravelly soil. The trunks of the iron oaks are covered with a lighter moss, on the whole, than fixes itself on the English oak; but make a fine appearance. I measured many outside trees, and observed that the iron oak seemed to have as great a superiority over the other, in this situation, as it has when surrounded by neighbours. As to the height, the iron oaks very generally out-top the others, and are the master trees; but you know that in a plantation a slender tree will often be nearly as tall as its sturdy neighbour.

"P.S.

"P. S. On looking over the oaks again, I think the iron oaks carry up the thickneſs of their buts a good deal better, *cæteris paribus*, than the others; and therefore they have five or ſix times the quantity of wood in them.

"There are but two beeches, and they are both outſide trees, and therefore larger than they otherwiſe would be. The circumference of the two was 12 feet 4 inches; average, 6 feet 2 inches.

"Spaniſh cheſnuts, No.			Circumference. Feet.	Inches.
6	——	——	31	3
8	——	——	34	3
4	——	——	24	3
18	——	18)	89	9
Average circumference			4	$11\frac{3}{4}$ nearly."

N. B. Mr. Babington ſays, "that there are gates and pales on the premiſes at Hillerſdon, which have been made of the iron oak; and that, as far as he can judge, the wood appears as hard and as tough as that of the common oak."

It has always been conſidered, that when men have planted oak, they have not planted for themſelves, or for their children, but for diſtant poſterity; and even *they* could never be repaid where land bore any annual value: and to the planter himſelf little pleaſure could ariſe from trees of ſuch very ſlow growth. But the ſame perſon who plants the iron oak may poſſibly live to reap ſome little profit as well as pleaſure; and it is not at all unreaſonable to ſuppoſe his immediate ſucceſſor may ſee it arrive to ſome degree of perfection. From what I have ſeen of the wood of this oak, and from the account given by Mr. Babington of the gates and pales made with it, there is great reaſon to ſuppoſe it will be equally uſeful as the Engliſh oak for any purpoſe whatever.

The general decreaſe of timber in this iſland, the many waſte lands unemployed, and the bill now propoſed to be brought into Parliament by that great friend to agriculture Sir John Sinclair, will be my apology for troubling the Society with this paper; for the planter ought certainly to be furniſhed with every advantage, and every poſſible inducement ſhould be held out to him for promoting ſo uſeful and ſo national a work.

Explanation of Plate XV. fig. 3.

A.a. a.a. Leaf, acorn, and prickly cup of the Iron, Wainſcot, or Turkey Oak.

B.B. b.b. Leaf, acorn, and prickly cup of the *Quercus Cerris of Linnæus, fol. oblongis, lyrato-pinnatiſidis; laciniis tranſverſis, acutis, ſubtus ſubtomentoſis; calyce hiſpido; glande minore.* Small-acorned Spaniſh Oak with prickly cups.

II.

Abſtract of a Memoir of M. PROUST *on the Tanning Principle*. By Citizen* DESCOTILS.

A SOLUTION of muriate of tin, at any degree of oxydation whatever, being poured into a decoction of nut-gall, forms an abundant yellowiſh precipitate. After having di-

* Annales de Chimie, xxv, 225.

luted

luted this mixture with a quantity of water ſufficient to ſeparate the laſt portions of preci. pitate which the acids may hold in ſolution, it is filtered, and the liquor contains the acids of galls, muriatic acid, and muriate of tin. The precipitate is a combination of the tanning principle, and the oxyde of tin. It cannot contain the gallic acid, becauſe this acid is not precipitated by tin. The ſolutions of lead, on the contrary, precipitate the gallic acid, as well as the tanning principle; and on this account it was that Scheele could not ſeparate the acid of galls from the principle of aſtringency.

In order to obtain the acid of galls, the tin muſt firſt be ſeparated by ſulphurated hydrogenous gas. The ſulphurated oxyde falls down in the form of a brown powder. After having left the fluid expoſed to the ſun, with a covering of paper, in order that the exceſs of ſulphurated hydrogen gas may be diſſipated or entirely decompoſed, it is to be filtered, and then evaporated, in a veſſel of ſilver, to the requiſite point for the cryſtallization of the gallic acid by cooling. The cryſtals being then thrown on a filter muſt be waſhed with a ſmall quantity of cold water. The remaining fluid is to be treated by evaporation, and cooling in the ſame manner, in order to deprive it as much as poſſible of gallic acid. At the end of the operation, it is neceſſary to uſe capſules of glaſs, becauſe the muriatic acid becomes concentrated. The earths which ſome chemiſts have pretended to exiſt in the decoction of nut-galls ought to be found in this reſidue. Mr. Prouſt met with none; but he propoſes to examine the reſidue with more particular attention to this point.

To ſeparate the tanning principle from its combination with the oxyde of tin, this laſt powder is diffuſed in a quantity of water, through which a current of ſulphurated hydrogenous gas is paſſed. The ſulphurated oxyde falls down, and the pure tanning principle at the ſame time becomes diſſolved in the water. After filtration, the ſolution is evaporated in a ſilver baſon, in which it acquires the deep colour of a decoction of nut-galls, and its peculiar ſmell, which is one of the diſtinctive characters of the aſtringent principle. Its taſte is exceedingly acerb, and rather bitter, without being diſagreeable. It lathers like ſoap-water, without feeling unctuous to the touch. It becomes turbid by cooling, and lets fall a light brown powder, which is diſſolved again by heat. It reſembles the laſt decoctions of nut-galls, which do not become mouldy, and are thought by Mr. Prouſt to contain the tanning principle nearly in a ſtate of purity.

The ſubſtance which remains after its evaporation is dry, brown, friable, breaks with a vitreous fracture, like aloes, and does not attract the humidity of the air. Its taſte is very rough and harſh: it is totally ſoluble in hot water, and ſtill more readily in alcohol.

All the acids precipitate the tanning principle from its aqueous ſolution, by uniting with it. As this fact belongs to the analyſis of galls, which Mr. Prouſt has made by means of the ſulphuric and muriatic acids, he promiſes to treat of it again in the ſecond part of his work.

The aqueous ſolution of the tanning principle, poured into a ſolution of glue, immediately converts it into a magma, which poſſeſſes the elaſtic properties of the gluten of wheat. This ſubſtance, when left to dry, contracts in its dimenſions, and, when perfectly dry, has the appearance of a brown maſs, vitreous in its fracture, not capable of putrefaction, perfectly inſoluble in water, yielding little to alcohol, and capable of reſuming its elaſtic property by ſoftening it in hot water. It is, in a word, ſays the author, the combination diſcovered by Seguin, the preſerving principle of tanned leather. It is alſo obtained with the ſolution of the nut-gall.

Albuminous

Albuminous liquors are precipitated by the tanning solution, but the result is not a magma susceptible of the same concentration.

The green sulphate of iron is no more altered by the tanning principle than by the acid of galls *.

The red sulphate, on the contrary, is precipitated in a somewhat tarnished blue deposition, which is abundant, coarse, and of a black colour when dry. If the precipitate which this sulphate affords with the gallic acid be compared with this, it will be seen that they greatly differ. The former is of an extreme subtlety, and remains long suspended in water: it is perfectly black, &c.

The gallate of iron is soluble in acids; the tannate of iron is decomposed by those salts. It abandons its iron, and the tanning part falls down.

If the red sulphate be poured, rather in excess, into a solution of the tanning principle, the disengaged sulphuric acid re-dissolves the precipitate, and affords a black fluid in its greatest intensity, which is blue when much diluted. To separate the precipitate, without depriving it of the tanning principle, it is necessary that the excess of acid in the fluid should be gradually saturated by pot-ash. With a little attention, the operator may succeed in rendering the liquor colourless, without affecting the superabundant portion of sulphate; or otherwise, if a small portion of oxyde of iron has been thrown down along with the black precipitate, which may be known by the rust which is formed upon the filter, a few drops of acid will re-dissolve it.

But it is a remarkable fact, that all the red sulphate remaining in the fluid is brought back to the state of green sulphate. The quantity of oxygen which constitutes the difference between the one and the other, is seized by a portion of the tanning principle. The latter thus oxyded, and by that means rendered incapable of precipitating the red sulphate, remains in solution. This oxydation of the tanning principle is directly and easily obtained by the oxygenated muriatic acid. The solution of the tanning principle, instead of becoming clearer, acquires a deeper colour, and loses all its peculiar characters in its transition to a new state, which Mr. Proust has not yet examined†.

The gallic acid undergoes the same alterations by the oxygenated muriatic acid, and, like the solution of the tanning matter, becomes incapable of precipitating the red sulphate. This is the effect which age produces upon ink. The gallic acid is destroyed, the red oxyde remains, and may easily be rendered blue by the method of Blagden.

As the astringent juices cannot afford indestructible inks, we must therefore return to the method of the antients, who used coal for this purpose. Perhaps, says Mr. Proust, there is no substance so proper as Spanish chalk. This stone, which is neither bituminous nor ampelite, is found with the amianthus, and is composed of alumine with six or seven per cent. of pure charcoal.

The same phenomenon of the oxydation of the blackening principle at the expence of the red sulphate, is also observed in black dyes made with sumac and this metallic salt. Mr. Proust had occasion to observe it in a bath of this kind, which no longer added to the black colour of the piece goods. The liquor was greenish; the red sulphate, or the oxygenated muriatic

* On this subject, see the interesting paper of this author, in our Journal, I. 453. N.

† See the observations of Seguin, Philos. Journal, I. 275.

acid,

acid, immediately formed black. Hence he concluded that the gallic acid, or the astringent principle and the green sulphate, existed together in the bath. The red sulphate which was poured in, combined with the vegetable principle; the oxygenated muriatic acid, by converting the green sulphate into red, gave it the facility of combining and affording black with the same principle.

From these facts it follows, that, in the process of dyeing black, a portion of the blackening principle, whether it be the tanning matter or the acid of galls, is destroyed by oxydation; that a certain period arrives at which the bath can no longer afford the black dye, unless, by exposure to the air, the iron can resume the quantity of oxygen necessary to bring it to the state of red oxyde; and lastly, that dyers would considerably accelerate their work by using the red sulphate. It would only be necessary in that case to provide against the excess of sulphuric acid, which always is found in the sulphate of iron when it passes from green to red. With regard to the use of logwood, verdigris, &c. Mr. Proust is convinced that these substances are not necessary, and that the most beautiful blacks may be obtained by astringents alone with iron.

III.

Notice of a Memoir of Citizen GUYTON, *upon the Tables of the Composition of Salts, and the Means of verifying the Proportions indicated by those Tables**.

THE little agreement between the tables of Bergman, Wenzel, and Kirwan shews all the difficulty of determining with exactness the proportions of the component parts of salts. A method of verifying such tables would therefore be useful to the progress of science. The following appears so simple and appropriate, that it is astonishing it has not yet been attempted. It consists in a comparison of the results of experiment and computation, with regard to the agreement of the very perceptible effect arising from the excess or deficiency of one of the substances after mutual decomposition.

For example, according to Bergman:

Sulphate of Barytes contains	Acid	13.
	Barytes	84.
Sulphate of Soda contains	Acid	28.
	Soda	16.
Muriate of Barytes contains	Acid	23,57
	Barytes	76,43
Muriate of Soda contains	Acid	52.
	Soda	42.

Neglecting the water, which, though of some consequence in the effect, is of none in the result; we see that, in the case of an exchange of bases between two salts, the result of the mixture must either be neutral, or possess an excess of acid, or an excess of the base; and that, by rendering the decomposition of one of the salts complete, we ought to obtain the same result from calculation as that which shall be afforded by experiment.

* Read to the National Institute of France, the 16th Prairial, in the year V. This notice is translated from the Annales de Chimie, xxv. 292.

Now,

Now, if by the sulphate of soda we decompose a quantity of muriate of barytes containing, according to the above table, 25,906 of muriatic acid, there ought to remain disengaged, or in excess, 16,710;—nevertheless the mixture remains neuter.

The fluid remains also neuter, if we cease to add the solution of sulphate of soda when the precipitate no longer falls down. The computation shews, that in a hundred parts of the mixture of these two salts, in which the muriatic acid would be represented by 20, there ought to remain 12 unsaturated, or in excess.

Let us apply the same method of verification to the proportions determined by Kirwan in the new tables in the second edition of his Dissertation.

It is known, that an exchange of bases takes place between sulphate of soda and muriate of magnesia. The computation established on the proportions indicated by the tables so rigorously assumed from the real acids, always shews a notable excess of acid, either muriatic or sulphuric, accordingly as the quantity of one or the other of these salts is increased in the mixture.

The doubts entertained by certain chemists on the respective decomposition of these two salts, have induced me to apply the same calculation to the inverse operation, that is to say, by mixing the solutions of sulphate of magnesia and muriate of soda; and in this case also the results do not agree.

Lastly, the method has been tried on a case of affinity, in which the decomposition immediately shews itself by unequivocal signs; that is to say, in the mixture of a solution of sulphate of potash and nitrate of lime.

According to the last data of Kirwan, the proportions of the component parts of these two salts, and the two others which ought to be formed, are as follows:

Sulphate of Potash -	Acid	100
	Potash	108,7
Sulphate of Lime -	Acid	100
	Lime	80,6
Nitrate of Potash -	Acid	100
	Potash	83,33
Nitrate of Lime -	Acid	100
	Lime	34,4

It is easy to form the mixture of a quantity of sulphate of potash, of which the acid shall be represented by the number 100, together with so much of the nitrate of lime that there shall be more than sufficient to cause the whole of the sulphuric acid to pass into a new combination. It is evident that, to effect this, 80,6 of lime will be required, which will therefore be disengaged from 234,4 of nitric acid; a quantity which would require for its saturation 195,32 of potash. But it finds only 10,87. The quantity of nitric acid remaining without any base, or in excess, must consequently be 64,87.

Such is the result of calculation; but experiment pronounces otherwise. The fluid diluted or concentrated, and even carried to crystallization, did not at any period present the least trace of disengaged acid.

The author declares in conclusion, that his intention is not to criticise experiments made with no less care than sagacity; but to offer to chemists a problem which is interesting in many respects, theoretical, practical, and even pharmaceutical; a problem of which the solution is no longer to be sought in the amendment of such errors as are unavoidable in manipu-

manipulations of great delicacy; but which also leads us to consider the consequences of the affinities in saline mixtures under a new point of view, in order to discover the cause of a result so little agreeing with all the observations which have yet been made upon their composition*.

IV.

On Pasigraphy; or, the Art of Writing which shall be intelligible to all Nations†.

CITIZEN Memieux has promised to assist us with a pasigraphy, or universal writing, by means of twelve characters which may be learned in twelve hours. This extreme simplicity is entitled to the utmost attention of philosophers, and seems to indicate a very superior mind in the author. We must nevertheless enquire, what may be the nature of these characters; for their form is of no great consequence. Are they alphabetical? Or, are they a kind of hieroglyphic, each expressing an idea, like the characters of the Chinese writing?

If the question relate to an alphabet, the secret is certainly not uncommon; but, if the characters be hieroglyphical, it will be difficult to comprehend how twelve primitive ideas and their representative signs can be sufficient for every combination. In either case, there is a new language to be learned, which, it is expected, the various nations will adopt. A Portuguese receives the information that a certain character, a cross for example, is to be made use of to denote a ship; the same information is communicated to an Indian; and, when these two men meet, if they trace a cross upon their tablets, they will both comprehend that a ship is meant,—and so of the rest. Without proceeding so far from the ordinary practice, I might say both to the Portuguese and the Indian, Write the word navis, and you will equally understand each other; or, in short, I might command all the people on the face of the earth to learn Latin, or any other common language, and then acquaint them, that this qualification would enable them to understand each other.

In this manner it is, that all the nations who have adopted the Arabian cyphers can readily communicate all their ideas of numbers and their combinations, notwithstanding the difference of their languages. When a native of France sees a German write 234, both have a perception of the same object, and understand each other perfectly, though the one in oral speech would say *deux cents trente quatre*, and the other *zwey hundert vier und dreisig*. Let the German continue to write numbers, and to perform the most complicated operations, the Frenchman will follow and comprehend them without difficulty. The algebraists of all nations understand at first sight the processes written by nations possessing other idioms. The same thing happens with regard to the signs of pharmacy, the ancient chemistry, astronomy, and music. Let a number of Italians, English, French, and Germans, be collected

* At the end of this paper, the author does justice, in a note, to M. Richter, who, in his Neuern Gegenstande der Chymie, &c. makes the same observation, to which he was led by the great difference between the proportions indicated in the tables already known, and those he had determined by a new method, which he calls stachiometrique. I hope to procure this work soon. N.

† From the Spectateur du Nord, Mai 1798. The signature V****** is annexed to this paper. I have omitted the two first paragraphs, which form no essential part of the subject, and are written in a style of levity which can scarcely accord with the rest of this excellent paper.—Reference to two Memoirs on the same subject, with a few remarks, is made in our Journal, II. 189—191. N.

together

together in an orcheſtra, perfectly unacquainted with each other, let the parts of the ſame ſymphony be diſtributed among them, and they will, by performing the muſical compoſition, afford a conviction, that, in ſpite of the difference of language, the muſical paſigraphy repreſents the ſame ideas to them all.—But in theſe ſeveral caſes of arithmetic, algebra, muſic, &c. it is evident, that nothing more has happened, than that all the profeſſors have been previouſly induced to learn one common language. This conſideration cauſes the miracle to vaniſh.

As an univerſal language, the paſigraphy is therefore a mere pretenſion: but there is another point of view under which it may be conſidered; as a philoſophical language, better conſtructed than all our ancient languages, which are the products of chance, caprice, and frequently of ignorance. There is no doubt but a profound metaphyſician, meditating at leiſure in his cloſet, and modelling all his expreſſions from the type of the original ideas, might ſucceed in forming a language more ſimple, and in every reſpect ſuperior to that which we ſpeak. This would be the language which we might then adviſe all nations to adopt, if they would conſent to abandon their mother-tongue and acquire a language common to all men: but this language, perfect as it might be, would not, in its own nature, be an univerſal language. We ſhould always ſpeak erroneouſly, if we were to aſſert, that the Portugueſe and the Indian, each writing his own language but with other characters, might underſtand each other. On the contrary, we ought to ſay, that if both acquire the philoſophical language, or paſigraphy, they will underſtand each other.

The whole edifice of this pretended diſcovery is therefore reduced to the propoſal of a new language more ſimple, more accurately eſtabliſhed upon the generation of our ideas, and which, on that account, is better adapted than any other to become the univerſal language, admitting it to be poſſible to introduce ſuch a general medium.

But this propoſition is not at all new, and cannot therefore be called a diſcovery. It has already been made by ſeveral men of the firſt rank in point of ability, who have acquired nothing more than the name of ingenious inventors, without prevailing on other perſons to ſecond their efforts.

A good hiſtory of paſigraphy would not be an uſeleſs work; neither would it be very eaſy to write ſuch a treatiſe. The materials are ſcattered through a multitude of ſcarce books not eaſy to be collected.

In this hiſtory we ſhould ſee what efforts have formerly been employed to confine human language within general and determinate rules; what principles have already been laid down, and the progreſs which this art has made in a few philoſophical minds. We ſhould judge to what extent the modern paſigraph has availed himſelf of, or departed from, the ideas of his predeceſſors. We can only preſent a few unconnected portions of this hiſtory*.

It is known, that lord Bacon of Verulam comprehended nearly the whole of human knowledge; that he diſcerned almoſt every thing which was wanting in the entire ſyſtem, and foreſaw moſt of the diſcoveries which have ſince been made. He laid the foundations of an Encyclopædia, and was very near diſcovering various important philoſophical reſults

* In the *Genius der Zeit*, i. 108, for the preſent year, an article is found, to which recourſe has been had in drawing up the preſent memoir. Note of the Author.

of experiments, ſuch as the weight of the air, &c. If we open his book on the progreſs of the ſciences, we ſhall find the notion of a paſigraphy in the chapter entitled The Inſtrument of Diſcourſe. "It is poſſible to invent ſuch ſigns," ſays he, "for the communication of our thoughts, that people of different languages may, by this means, underſtand each other; and that each may read immediately, in his own language, a book which ſhall be written in another." But Bacon did not think of confining this to twelve characters: on the contrary, he requires a great number, at leaſt as many as the number of radical words; on which head he quotes the example of the Chineſe; "and although," adds he, "our alphabet may appear more commodious than this method of writing, the thing itſelf is neverthele ſs well deſerving of attention. The problem relates to the ſigns by which thoughts may be rendered current; and as money may be ſtruck of other materials as well as gold and ſilver, it is poſſible likewiſe to diſcover other ſigns of things as well as letters and words *."

Des Cartes, in his third letter to father Merſennus, diſcuſſes the invention of a Frenchman, whom he does not name, but who, by means of a certain language and an artificial writing, pretended to underſtand all the different idioms. He remarks on this ſubject, that it would be very poſſible to compoſe a ſhort and convenient grammar, with general ſigns, which ſhould render all foreign languages intelligible. Here are already two works on the paſigraphic art; but we ſhall proceed to exhibit circumſtances of a more poſitive nature.

In the year 1661, John Joachim Becher publiſhed a Latin folio, the title of which was "Characters for the Univerſal Knowledge of Languages: a Steganographic Invention hitherto unheard of" †. This unheard of invention was no other thing than what is now announced to us under the name of Paſigraphy; it is a method of making one's ſelf underſtood by all foreigners by writing in one's own language, and alſo of comprehending what they write in theirs. It was truly at that time a thing unheard of; for Becher, being the firſt who had given a complete treatiſe on this art, may be conſidered as the inventor. He begins his work by a ſet of very delicate and highly intereſting obſervations upon general grammar, and the fundamental relations of all languages with regard to each other. He gives a learned comparative table of the relations and harmony of the Latin, the Greek, the Hebrew, the Arabian, the Sclavonian, the French, and the German. This work cannot be too highly eſteemed, and aſſuredly was not unknown to the author of the work *Du monde primitif.* A Latin dictionary then follows, in which every word correſponds with one or more Arabic numeral figures arbitrarily taken. Every number is aſſumed as diſtinctive, or denoting the ſame word in all languages; and conſequently nothing more is required than to compoſe a dictionary for each, ſimilar to that which he has given for the Latin. There is likewiſe a table of declenſions and conjugations, which preſents certain determinate numbers for all the caſes, moods, tenſes, or perſons. By means of this general diſpoſition, when a Frenchman is deſirous of writing to a German the following phraſe, *La guerre eſt un grand mal* (war is a great evil), he ſeeks in his index, *guerre*, *être*, *grand*, *mal*; and he writes the correſpondent numbers,

13, 33, 67, 68.

* I have tranſlated from my original, inſtead of recurring to the book of chancellor Bacon, which I do not poſſeſs The paſſages marked as quotation, are not therefore the words of Bacon, but his ſenſe. N.

† The author has not given the Latin title of this work. I have therefore tranſlated his French title word for word. N.

The

The sentence might be understood by these four characteristic numbers; but to leave no room for ambiguity, he says, *Guerre* is the nominative case, and finds, as the characteristic of the nominative, the Arabic figure 1. *Est* is the third person singular of the indicative mood, present tense, of which the characteristic is 15. To *grand*, and to *mal*, belong likewise the figure 1, for the nominative case; he will therefore write

13.1 | 33.15 | 67.1 | 68.1 |

where the numbers are separated by small vertical bars to prevent confusion. It may easily be conceived how, by the inverse method, the German will find in his tables the words denoted by the cyphers, which will form *Der krieg ist ein grosses uebel.*

This invention of Becher, which is the same thing nearly with regard to language, as algebra is to arithmetic, could not have cost him any great effort of the imagination; and it evidently reduces itself, as I have observed with regard to all pasigraphy, to the learning a new language, or having a dictionary at hand for use. It is besides possessed of considerable simplicity, and even a few hours practice will render it easy. If any reader should be curious to see more applications of this kind, he may have recourse to the Latin work of Sturmius, *Essais d'Expériences curieuses* *.

In the same year George Dalgaru, an Englishman, published at London, a work of which the prolix title is sufficient to shew its object. It is, "The Art of Signs, or an Universal Character and Philosophical Language, by Means of which, Men of the most different Idioms may, in the Space of two Weeks, learn to communicate, whether by Word of Mouth or by Writing, all their Thoughts, as clearly as in their Mother-tongue. Besides which, young Persons may therein learn the Principles of Philosophy, and the Practice of true Logic, more speedily and more readily than in the ordinary philosophic Writings." The book of Dalgaru is written in Latin †. Becman accuses him of extreme pedantry. I do not know whether this book is common in England, but it is very scarce on the Continent. His characters likewise were cyphers.

Joachim Frischius, professor at the Gymnasium at Riga, was employed on a similar attempt, namely, to introduce a natural, rational, and universal language, of which some sheets printed at Thorn in 1681 may give an idea. The death of the author interrupted his labours. He purposed to call his new language Ludovicean, in honour of Louis XIV. under whose patronage he pursued his labours; a prince who extended his generosity to the learned of all countries.

The curious in researches of this nature may also find a project of this kind in a folio volume published at Rome in 1665, by the celebrated mathematician Athanasius Kircher, the title of which is, "A New and Universal Polygraphia, deduced from the Art of Combination ‡;" and by means of which, says Morhoff (Polyhistor. l. ii. c. 5.), he who understands one single language only may correspond in writing with all the nations of the earth.

* I suppose this work to be the *Collegium experimentale, sive curiosum, &c. Joannis Christophori Sturmii*, 4to. Norimberg, 1701. N.

† I know nothing of this author, nor his work. The title in the text is translated verbatim from the French. N.

‡ Neither Moreri nor any other biographer at present within my reach has given the title of this work of the voluminous Kircher. N.

It

It would be perhaps unjuſt to paſs in ſilence the little-known work of father Beſnier, Jeſuit, who in a book entitled *La Réunion des Langues, ou l'Art de les apprendre toutes par une ſeule*, that is, The Union of Languages, or Art of learning all Languages by one alone, printed at Paris in 1674, has given ſeveral intimations which lead directly to paſigraphy.

The moſt remarkable work of all which has been written on this ſubject is, perhaps, that for which we are indebted to biſhop Wilkins, the brother-in-law of Cromwell. It is entitled, An Eſſay towards a Real Character and a Philoſophical Language, London 1668. It is divided into four parts. I. Conſiderations on the various languages, their defects and imperfections, from which a philoſophical language ought to be exempt. II. Philoſophical enquiries reſpecting all the things and notions to which proper names ought to be aſſigned. III. The organic ſcience of native grammar conſidered as the neceſſary means of repreſenting ſimple ideas in diſcourſe. IV. The application of the general rules to every character and language. Examples, &c. This conciſe outline ſufficiently ſhews the importance of the work *.

In his appendix, the author explains the utility of a method of writing without alphabetic characters, by means of ſigns, which are to be uſed to denote all the principal ideas, the relative attributes being deſignated by ſmall ſtrokes added at right, acute, or obtuſe angles, to the right or left, &c. Of principal or chief ideas he admits but forty, under which he ranges all the others, by that means forming a kind of categories. His new language is calculated to afford great facility of comprehenſion, and new openings to the reaſoning proceſſes of ſcience. A learner might make more progreſs in it in a month, than in the Latin in ſeveral years †.

After ſo many attempts more or leſs philoſophical, and of different degrees of perfection, with others probably of which we know nothing, we muſt not overlook the efforts of the celebrated Leibnitz for the introduction of a paſigraphy. His Hiſtory and Developement of a Characteriſtic Univerſal ‡ Language is in every library. Leibnitz exhibited, and with reaſon, his univerſal characteriſtic as the art of inventing and judging. He was convinced that an alphabet might be formed, and of this alphabet ſuch words as would afford a language capable of giving mathematical preciſion to all the ſciences. "Men may thus acquire," ſays he, "as it were a new organ, which would add energy to their moral faculties, as the microſcopic lens increaſes the power of the eye. The compaſs is not more highly

* Wilkins's Eſſay towards a Real Character and a Philoſophical Language is a thin folio of 454 pages. A dictionary of Engliſh words, referred to their places in the forty tables, was printed at the ſame time (1668), and of the ſame ſize. Theſe books are not very ſcarce. They contain a treaſure of information with regard to the objects comprehended in the ſcheme for a philoſophical language; but neither this, nor the character itſelf, as the biſhop has left them, appears to be enough completed to attract the attention of the world by their facility. Dr. Robert Hooke, whoſe prodigious abilities give a ſanction to whatever he approved, did actually learn it, and publiſhed ſome valuable philoſophical information on an engraved plate in this univerſal character, with a view to excite others to acquire the means of peruſal. N.

† The Chineſe writing, which is a very complicated paſigraphy, has given two learned men the idea of forming one upon a more ſimple plan. The firſt is Caramuel, in his *Apparat Philoſophique*, page 128; and the other Andrew Muller Grieffenhag, in his *Clé Chinoiſe*. The latter promiſed to teach to women and children, in the courſe of a few days, a kind of writing by which all the ſeveral languages ſhould be rendered intelligible to them. Note of the Author.

‡ *Hiſtoria et commentatio linguæ characterica univerſalis, quæ ſimul ſit ars inveniendi et judicandi.* Oeuvres Philoſ. Lat. et Françoiſes de Leibnitz, données par M. Raſpe.

valuable

valuable to the navigator, than this philoſophical language would be to him who embarks on the ſea of reaſon and experiment, which is now ſo full of danger."

We muſt not forget the ingenious method of the abbé de l'Epée, who, by means of the ſame identical geſtures, dictated to his deaf and dumb pupils certain diſcourſes, which they wrote with equal readineſs in four languages. Nothing can more aſſuredly reſemble a true paſigraphy than theſe geſtures.

The abbé de Condillac, a ſubtle metaphyſician, particularly with regard to human language, has not neglected ſigns and characters. In his Art of Thinking (*Art de penſer*), in his Art of Writing (*Art d'écrire*), and more particularly in his Logic, he has ſhewn the advantages of a philoſophical language, which ſhould proceed perfectly in the order of the ideas, and of which the ſigns ſhould be the moſt ſimple and analytical. He expreſsly reduces the ſtudy of all the ſciences to that of a well conſtructed language, and quotes, as an example, algebra in the mathematical ſciences.

Strengthened by ſuch aſſiſtance, ſupported by the reſearches of ſo many predeceſſors, it muſt no doubt have been eaſy for Citizen Memieux to have conceived and executed the idea of a paſigraphy. To judge how far he is an inventor, to diſtinguiſh what excluſively belongs to him, it is neceſſary to examine and perpetually compare his work with all thoſe we have pointed out, and no doubt with many others which have eſcaped our notice.

Will this new author be more fortunate than Becher, Kircher, Wilkins, and Leibnitz? Will he eaſily perſuade the nations to learn the new language he propoſes? Of this we may ſtill reaſonably entertain ſome doubt. However this may be, it is to be hoped that a paſigraphy will hereafter be eſtabliſhed. In thoſe ages of peace, leiſure, and union, of which the proſpect is held out to us by M. Kant, men will have no object of more importance than to give perfection to their language, and to liſten to the voice of philoſophers, who ſhall propoſe to them a better ſyſtem of ſpeech. If it ſhould not be admitted in the lower claſſes of ſociety, it will at leaſt become the learned language of all the earth. On this ſubject I will venture to ground a comfortable hope, which tends to encourage the mind under its aſtoniſhment at the dreadful deluge of books which at preſent inundates the world.—Thoſe books only will be tranſlated into the learned language which deſerve the trouble: the moſt ſalutary ſcrutiny will take place; and the reſt will go to heat the baths. Philoſophers, literary men, authors of every deſcription, be aſſiduous, compoſe works of value, and be aſſured that your writings and your names will eſcape oblivion by means of the paſigraphic invention. In the mean time, till the arrival of this great epocha, one of the languages at preſent in uſe, one of the moſt imperfect in many reſpects, becomes every day more extended in its uſe * * * * *

V.

Obſervations on the Natural Hiſtory of Guiana. In a Letter from WILLIAM LOCHEAD, *Eſq. F.R.S. Edin. to the Rev. Dr.* WALKER, *F.R.S. Edin. Regius Profeſſor of Natural Hiſtory in the Univerſity of Edinburgh.*

[Concluded from Page 304, Vol. II.]

BESIDES theſe two kinds, there are alſo what we may denominate half ſavannahs, formed upon the tops of ſand-hills, higher and more irregular than in the caſe of thoſe juſt deſcribed.

deſcribed. Some of theſe are alſo very extenſive. Few herbaceous vegetables are to be met with upon them. Broad ſpaces of arid ſand are interſected by clumps of ſhrubbery. Nothing grows to the height of a tree; but a particular ſet of plants, different from thoſe in other parts of the country, find ſubſiſtence enough to riſe to fifteen or thirty feet. How Nature, after all her efforts, ſhould have failed to induce a ſoil upon theſe is ſurpriſing. It appears chiefly owing to the great poroſity of the ſand, which every where admits the decayed vegetable matter deſtined for that purpoſe to be carried down through it, and filtered off by the rain. Even thoſe ſand-hills which are covered by tall trees, ſtill ſhew proofs of this. The trifling layer of mould formed upon them is exceedingly thin. When cleared, they are very barren; and when you dig in them to a great depth, you ſtill find ſmall portions of black vegetable earth diſperſed among the ſand. What corroborates the above ſuppoſition is the appearance of the ſprings. Abundance of theſe are found guſhing out copiouſly round the verges of the hills; and notwithſtanding the extreme whiteneſs and purity of the ſand from whence they flow, there is not one in an hundred whoſe waters are limpid. They come out not muddy, but of a browniſh colour, very much like the water which runs from peat-moſſes, and they are certainly tinged by the ſame cauſe. The rotten leaves of trees, and other decayed parts of vegetables on the hills, inſtead of being collected on the ſurface to form ſoil, are waſhed down into the ſand ſtrata by every rain; ſo that the reſervoirs of the ſprings, and the water which proceeds from them, are always coloured with theſe ſubſtances. There follows a corollary alſo from this general principle, and, when compared with facts, I believe it will hold good: The more the ſand is concreted into ſtone in any of the hills, the more and better will be the ſoil upon them. Where clay in ſmall beds, or in a certain proportion, is mixed with the ſand, the vegetable mould will likewiſe be better retained.

Rivers.—I will next give you what general obſervations I have been able to make upon the rivers and creeks of this part of America. The courſe of nearly all thoſe of Guiana is from ſouth to north. They originate in a chain of hills running eaſt and weſt, which ſeparates Guiana from the country of the Amazons, and likewiſe gives riſe, on its ſouth ſide, to the numerous br..nches which fall into that river. The Demerary is a conſiderable ſtream, equal if not ſuperior to the Thames; yet it is by no means among the largeſt of them. The Eſſequebo is five times larger at its mouth, forming a whole Archipelago of iſlands; but its ſtream ſoon divides, and, on account of rocks, ſhallows, and rapids, none of its branches are navigable ſo high up as the former. Moſt of the particulars I am now to give you, muſt be underſtood as applying to the Demerary. The bar, if it may be ſo called, is common to this with many other rivers which diſcharge themſelves into a ſhallow ſea; but ſtill with circumſtances in the preſent caſe which diſtinguiſh it from others where the bottom is not mud but ſand. It does not run like a ſingle narrow ridge, acroſs or nearly acroſs the mouth of the river; but it is of great extent, and is properly a continuation of the mud-bank which runs all along the coaſt. To the eaſt and weſt, and for two miles or more in the offing, you have ten or twelve feet water, with the utmoſt uniformity; and ſtanding in with the mouth of the river open, you neither deepen nor ſhallow till you enter it, when you find two, three, four, and five fathom; and it continues to average that depth for a long way, ſo that any veſſel which can enter, may, for draught of water, proceed up the river for 100 miles or more.

The

The mouth of the Eſſequebo, from the ſand-hills and rocks being very near it, is exceedingly different. Three large iſlands preſent themſelves in a breaſt, and divide its entrance into four channels. The length of theſe iſlands is, with the current, ſouth and north; and from the tail or north end of each of them, as alſo from the banks of the main, or either ſide, run out ſand-banks to a good diſtance. They are perfectly firm, quick in very few ſpots, and the body of them is above the level of low water. On the outſide of them, you have the continuation of the mud-banks and ſhallow water, as above, only that the entrance of theſe channels is ſtill ſhallower than that of the Demerary. The ſtream of this river runs very brown and muddy, and the ſea is ſtained with it for ſome leagues off. A ſtranger naturally imputes this to the waſhings of a large flat country, or the ſtirring up of the muddy bottom by the tides. The latter may in part be a cauſe, though I believe it contributes to it but very little, and the former in a ſtate of uncultivation, none at all. On aſcending forty miles or ſo, you find the water clear again, or rather of a darkiſh hue; and ſo it continues above that. I was at firſt at a loſs how to account for this; but, from a number of circumſtances, was ſoon led to conclude that the thickneſs and light brown colour of the water near the mouth of the river, and on the coaſt, were almoſt entirely the effect of cultivation. Numberleſs ditches and canals have been opened by the inhabitants, which are receiving or diſcharging water every tide; and each particular piece on a plantation is every way interſected with open little drains, which communicate with theſe ditches. In digging and hoeing this clayey ſoil, much of it is ſuſpended in the water, and carried off by the current of the tides. Nothing can be more certain, than that all up the river, and in all the creeks which diſcharge themſelves into it, the colour of the water is conſtantly clear or blackiſh, even in the rainy ſeaſons when it is ſwollen. On conſidering theſe circumſtances, I have been led to this general concluſion, which is ſubmitted to the proof of obſervation in different parts of the world. The reddiſh brown colour ſo common in freſhes of rivers in Europe, and we may add every where, is almoſt entirely the effect of cultivation; and the natural colour of rivers, even in the higheſt and longeſt continued floods, where all the country is ſtill in woods or paſtures, is ever that of a dark brown, or blackiſh, pretty much like that of the ſtreams which riſe among peat-moſſes, but rather more diluted. It is comparatively very clear, and depoſits but a trifling ſediment. The other is thick and opaque, and its ſediment copious. Thus is man, in his little workings, made in a ſmall degree one of the engineers of Nature. We cannot doubt that entire ſtrata will owe to him their exiſtence, accumulated in a ſeries of ages at the bottom of the ſea, and deſtined in future revolutions to act a more diſtinguiſhed part. It may be curious, too, to conſider the differences that may be expected betwixt the ſtrata formed by theſe different depoſitions, which may be ſuppoſed between them to have been the origin of moſt of the clays upon our globe. Clay, earth, or loam, ſtirred up by the labourer, gives riſe to the one: minutely decayed parts of vegetables form the body of the other.

It muſt alſo be obſerved, that clearing the ground along the coaſt, by cutting down trees, and opening ditches for the diſcharge of water, has expoſed the land very much to the waſhing of the ſea. The roots of the mangroves formed a plexus able to reſiſt its force, and the former equal and very ſlow deepening of the water prevented its making a ſtrong impreſſion on any place. The diſcharge from the ditches at low water cut out channels in the mud, and left the ſides of theſe channels more expoſed to the returning waves, which here

here beat continually upon a lee ſhore. We find therefore on the coaſt, that the ſea has made here and there conſiderable encroachments, which generally begin on the weſt ſide of the canals or ditches, as being the moſt acted upon by the waves. The mouth of the Demerary itſelf furniſhes us with a ſtrong inſtance. That river is now nearly twice as wide as it was when the country firſt began to be cleared, the ſea and the ſtream together having ſince that ſwept away a large portion of land from the weſtern ſhore.

Creeks.—A number of creeks fall into the Demerary on both ſides, but ſo ſmall that they bear no proportion to the ſize of the river. You can hardly diſtinguiſh their mouths in the woods which overhang the banks. They are ſo narrow, that it is difficult to run a ſmall boat in them; yet you will find in them throughout from two and a half to four fathom water, and they run winding ſo far back that it will take five, ſix, eight hours, or more, to carry you up to their heads, where they terminate in ſmall ſtreams from among the ſand-hills. The banks of the creeks, at their mouths, are of the ſame height as thoſe of the river cloſe, from five perhaps to twelve feet above the water in the dry ſeaſon. As you aſcend the creek, you might naturally expect to find them riſe. It is, however, the very reverſe; they become gradually lower and lower, till at laſt all round them is a ſwamp: and the trees on each ſide, in like manner, become ſmaller and ſmaller, and of different ſpecies from what they were. It is now, in ſhort, exactly a mangrove ſwamp, with this difference, that the water is quite freſh, the vegetables are not the ſame, and there are abundance of arunis and other low herbaceous plants. A little higher up, you loſe the wood altogether, and find yourſelf in a beautiful deep canal, winding through a ſpacious wet ſavannah, which is ſometimes many leagues in circumference. The firſt time we went up one of theſe creeks (called Camouni), I was ſurpriſed at this appearance, and thought it muſt be a mere local circumſtance peculiar to it. We found afterwards the ſame in one or two more inſtances, and were ſatisfied upon enquiry that it is common to them all. It was natural to look for an explanation of this phenomenon, and I ſoon found it in one of thoſe laws which probably extend to all rivers ſubject to frequent inundations. It has been obſerved in particular of the Ganges*, that the banks of that river are higher than the adjacent lands at a diſtance from the ſtream, owing no doubt to the annual depoſitions of mud, &c. during the ſwell of the river. Apply the ſame rule to the Demerary, and the difficulty will be ſolved. The wet ſavannahs behind, and the ſwampy woods around them, are the body of the low country, at its natural level ſcarcely a foot or two above the ſea. Whatever additional height the land has in the vicinity of the river, from the time you have aſcended about twenty miles or ſo, is all acquired. It has riſen from the ſediment of the river during the rainy ſeaſon, when the country is overflowed, ſo as that all the lower part of it is under water. This depoſition muſt be always more copious in proportion as it is nearer the ſtream, where additional quantities are always brought, and where it is kept in motion both by the current and the tide.

Every thing we afterwards ſaw confirmed this theory, and nothing more directly than the canals which run out at right angles from the river. Some of theſe extend four miles inward, and they prove to a demonſtration that the land becomes lower and lower the farther you recede from the river. The maps of the colonies confirm it; for in all of them

* Account of the Ganges, &c. Phil. Tranſ. 1781, by Major Rennell.

the

the main body of the low land of Guiana is laid down as ſavannah; and the woody country, which a ſtranger or ſuperficial obſerver would ſuppoſe to be the whole, or much the greater part of it, is in fact only a border on the ſides of the rivers and of the ſea, but of conſiderable breadth, more or leſs in proportion to the ſize of the adjoining river, or, which is generally the ſame thing, to the acquired height and extent of the ſoil on either bank. It followed as a conſequence, and as far as we had opportunities of obſerving found it to be the caſe, that the low land was ſomewhat higher, and continued ſo farther down about the Eſſequebo, than the Demerary; the woods, conſequently, were of greater extent. We found, beſides, in the ſoil adjoining the Eſſequebo, at leaſt upon the eaſt ſide, a mixture of ſand. The river is full of ſand-banks; and it appears, that the finer parts of even this leſs ſuſpenſible ſubſtance are raiſed by the floods, and carried among the adjacent woods, to be depoſited with the mud. The Mahayka, a ſmall river or creek, which falls into the ſea about twenty or thirty miles to the eaſtward of the Demerary, though it runs a long way up the country, and ſpreads into many branches, has but a very narrow and often interrupted border of wood upon its banks; it runs through an immenſe ſavannah, and ſo do its branches, with little or no wood till they approach the ſand-hills. The Deltas of the river of Oronooko, and its numerous mouths, make a figure even in the map of the world. It is to be regretted that its noble ſtream has been ſo long hid from ſcience. What I learned in Trinidad, from a gentleman who had ſailed from its mouth to the Anguſturas, about 300 miles up, confirms and illuſtrates, in the fulleſt manner, the above general rule. The weſtern mouths of it, oppoſite Trinidad, are navigable only for launches drawing ſix or ſeven feet water. At and oppoſite them the bottom is ſhallow and muddy, and the coaſt a low mangrove ſwamp, reſembling in all reſpects that of Guiana. You muſt aſcend thoſe branches ſeveral days before you reach the main ſtream; and in doing ſo you find the ſame phenomena as in aſcending the Demerary, but in a ſtill greater degree. At firſt you have the mangrove, or ſome ſimilar ſwamp, and behind it, on both ſides, for about twenty leagues, the land, if you can call it ſo, hardly emerging from the water. Afterwards the ground appears; and, as you go up, riſes ſtill higher and higher on the banks above the common level of the ſtream. The trees become in the ſame manner of different ſpecies, and much taller than they were below. The channel in which you are, from being wide grows narrower by degrees. It is from about one and a half to three-fourths of a mile broad near the entrance, and when it joins the main ſtream is not more than about 200 yards. It has then acquired a conſiderable depth, and the banks may be about 20 feet high. Along the main ſtream of the river, or Boca de Naſios, the gradual riſe, and other circumſtances attending it, are quite ſimilar. All this height of the bank, I can make no doubt, is entirely acquired ground, formed by the ſediment of the floods, greater near the ſtreams than at a diſtance from them; and though I have no knowledge of the nature of the land in the Deltas and their vicinity, I would not heſitate to ſay, that great part of the interior body of each iſland, and moſt probably of the main, on either ſide where it is low country, conſiſts of nothing elſe than wet ſavannnahs.

Floods.—Before we leave the rivers, it may be proper to take notice of their floods. In no inſtance of a large river does the univerſal law within the tropics fail, that they annually overflow their banks for a certain ſeaſon. What was a prodigy in the Nile during the

the infancy of ſcience, is now a well-known phenomenon to every inhabitant of a continent in the torrid zone. From the ſituation of the river Amazons, it amounts to a certainty, that the Demerary, Eſſequebo, and other rivers of Guiana, cannot originate very far up in the continent of South America. This is confirmed by what I could learn of the riſe and duration of the floods of theſe two rivers. Enquiring about them at the plantations below is to little purpoſe, for there the floods are hardly diſcernible; but by the poſt-holder, and the ſettlers fartheſt up, I was informed that they are there ſenſible enough, and that, independent of all partial ſwells from accidental rains, the Demerary generally roſe every year in the month of June, and continued high through July and part of Auguſt. The riſe there upon the whole might be about twelve feet; it is ſufficient to lay the level parts of the country under water, and to render the woods that cover them in ſeveral places paſſable in canoes. We could have wiſhed for more exact information. This, however, was ſufficient to prove that the rivers did not riſe very far inland, elſe the floods would have been later in the year; but at the ſame time that they were of extent enough to follow the rule of all conſiderable intertropical rivers, ſo as to have a flood in the rainy ſeaſon, that is, in the months when the ſun is upon the ſame ſide of the line on which they have their origin and courſe.

The great Oronooko, I have been informed, begins to riſe a little in May: it continues increaſing through the ſummer months, and the inundation is at its height in September. At that time, as far up as the Anguſturas, the riſe is above forty feet perpendicular above the low water mark. It diminiſhes as you deſcend, till about the mouth, where it is only a very few feet.

Tides are of the utmoſt conſequence to the inhabitants of the coaſt of Guiana. They enable them to drain a country which otherwiſe would never have been cleared, and they aſcertain their journeys, which are made by water up and down the rivers, and even along the coaſt. At the mouth of the Demerary it is high water at about half paſt five, at new and full moon. The riſe in ſpring tides, a little way up, is twelve feet or more above low water mark. The tide runs very rapidly near the mouth of the river, ſeldom leſs than four or five miles in the hour. It continues to run with force for a long way up, and was ſufficient without wind to carry us up or down at 150 miles from the mouth. Above that it becomes feebler; and for a conſiderable diſtance below the Rapids, though there is a ſenſible riſe and fall of two or three feet, yet even in the dry ſeaſon the current is conſtantly down, only more gentle during the riſe or flood; and there alſo the continuance of the riſe is very ſhort, not more than two or three hours.

Some obſervations upon the ſoil of the different parts of the country may be the ſubject of a future communication. I will only add, at preſent, what I think has more than conjectural foundation; viz. that this moſt recent of countries, together with the large additional parts ſtill forming on its coaſt, appear to be the productions of two of the greateſt rivers on the globe, the Amazons and the Oronooko. If you caſt your eye upon the map, you will obſerve, from Cayenne to the bottom of the Gulph of Paria, this immenſe tract of ſwamp, formed by the ſediment of theſe rivers, and a ſimilar tract of ſhallow muddy coaſt, which their continued operation will one day elevate. The ſediment of the Amazons is carried down thus to leeward (the weſtward), by the conſtant currents which ſet along from the ſouthward and the coaſt of Brazil. That of the Oronooko

nooko is detained, and allowed to settle near its mouths, by the opposite islands of Trinidad, and still more by the mountains on the main, which are only separated from that island by the Bocos del Drago. The coast of Guiana has remained as it were the great eddy or resting-place for the washings of great part of South America for ages ; and its own comparatively small streams have but modified here and there the grand deposit.

W. LOCHHEAD.

VI.

On the supposed Revival of Insects after long Immersion in Wine or other intoxicating Liquor. By Mr. JOHN GOUGH.

To MR. NICHOLSON.

SIR, Kendal, Oct. 7, 1798.

TO attack the opinions of any man is a disagreeable task, especially if such opinions have been favoured by persons of the first reputation in their respective pursuits. The force of the preceding reflection has embarrassed me not a little in my present attempt, which presumes to controvert a notion relative to the nature of insects, supported by the authority of Dr. Franklin. This acute and industrious philosopher maintains, that flies drowned in wine will revive, days, or even months, after their immersion, upon being exposed again to the air and sun. The Doctor does not profess himself to be the author of the opinion, but supposes he saw it confirmed by an incident which he witnessed in London, where discovering two flies in a vessel that was employed to decant a bottle of Madeira wine that had been brought from Maryland, and concluding, perhaps too hastily, that the flies were imported from America in the bottle, he exposed them to the sun : one of the two revived in a little time, and flew away ; but the other could not be restored to life by this artless method of resuscitation. After stating the fact, the Doctor proceeds to entertain his readers, according to his custom, with some lively reflections, which would have been not less important than they are amusing, had the premises been well founded ; but I am persuaded that a more careful repetition of the experiment would have determined this ingenious observer to relinquish a notion which his high name has made current with the physiologists of the present day.

In order to obtain that information and certainty respecting the subject which cannot be had from casual observations, I have repeated the experiment on a number of insects, drowned for the purpose in wine and other intoxicating liquors ; an account of which trials is related in the sequel of this letter.

Experiment 1. Two large blue flesh flies (*musca vomitoria*), which had been immersed in a phial of red wine, with a view to this experiment, on the 12th of July 1793, were exposed again to the sun and air, on a piece of black silk, in a window, on the 20th of August the year following. In this situation they remained two days without shewing any signs of returning life ; on the contrary, they were found dry and shrivelled, though their bodies appeared plump and in high preservation when taken out of the bottle.

Experiment 2. I repeated the preceding experiment on a number of flies, making use of Madeira and other kinds of wine, as well as brandy and beer ; the time of immersion being

being varied from two hours to three or even four days; but the same want of success attended all these trials; for not one fly which had been rendered torpid by intoxication could be restored to life.

Experiment 3. Flies which were taken out of the wine two or three minutes after they ceased to shew indications of life, recovered, not only when exposed to the sun, but also when placed in a temperature kept high by means of the human breath for the space of six or eight minutes.

The two first experiments taken in conjunction with the last seem to insinuate, that the doctor was deceived in supposing his flies to have been imported from America; for the eagerness with which these insects repair to vessels containing spirituous and fermented liquors, makes it much more probable, that they were attracted by the smell of the wine into the funnel, from which they were extricated in a little time, but not before one of the two had been too long immersed to recover; and unless some circumstances of importance have been overlooked in the preceding attempts, flies made insensible by vinous spirit are subjected to the same law of suspended animation which determines the fate of animals drowned in water.

I will even venture to advance a more decisive proposition on this head, in pronouncing alkohol highly pernicious to the living principle in insects, which it destroys with certainty, but not with equal expedition in every kind; for, if the effects of this fluid on these diminutive animals be compared with the injuries they experience in the air-pump, intoxication will appear to kill them in a much shorter time than the absence of oxygen. Dr. Derham found, that several insects, which he specifies, revived on the re-admission of the air, after remaining torpid, in some instances, as long as 16 hours in an exhausted receiver. (See Physico-Theology, chap. 1. note F.) But life seems to be extinguished in a much shorter period by spirituous liquors.

The foregoing experiments being confined to common flies, or those with one pair of wings, I thought it not improper to extend the enquiry to a greater variety of insects, which was done accordingly in the course of the last summer. But these trials discovered nothing remarkable, except the power of the Nut Weevil (*Curculio Nucum*) to resist the destructive effects of alkohol *. This constitutional singularity has been noticed prior to the present essay; but unless my experiments were made under some unfavourable circumstances, the property in question appears to be exaggerated.

Experiment 4. I immersed several maggots taken out of hazel-nuts in brandy: these were afterwards inclosed in fresh nuts opened for their reception, and placed in a temperature varying from 70° to 80°. The maggots, which had been confined in spirit for a period not exceeding 17 hours, revived; but when the time of immersion was prolonged to three, or even two days, every attempt to restore them proved fruitless.

Having now stated the most striking facts of my experiments fully, I will close the subject by forming the rest into a table, expressing the number of insects of each kind that have been killed by immersion in wine, brandy, and beer. Those marked with an asterisk, being such as delight in the shade, were shut up in perforated chip boxes after immersion, and placed in a warm temperature.

* The maggot of the filbert will remain torpid, but not destroyed, in a phial of brandy, though bottled up for many weeks. (Good on the Diseases of Prisons, p. 174.)

Name.

Name.	Wine.	Brandy.	Beer.
Scarabæus fimetarius, - - -	—	1	—
Curculiones Nucum *, - - -	—	18	—
Grylli domestici *, - - -	4	2	1
Erucæ Phalenarum, - - -	—	20	—
Panorpæ communes, - - -	—	2	—
Vespa vulgaris, - - - -	—	1	—
Apes mellificæ, - - - -	2	1	—
Tipula oleracea, - - - -	—	1	—
Muscæ vomitoriæ, - - -	2	—	—
Muscæ carnariæ, - - - -	4	2	1
Muscæ domesticæ, - - -	7	5	—
Tabani decutientes, - - -	6	4	3
Asilus crabroniformis, - - -	—	1	—
Araneæ domesticæ *, - - -	4	2	6
Onisci Aselli *, - - - -	3	2	3
Scolopendræ forficatæ *, - -	1	1	2
	33	63	16

JOHN GOUGH.

VII.

Various Notices respecting the Practice of the Arts in Turkey.—Jeweller's Foil.—Glue, or Mastic, for Stones and Metals.—Casting of Malleable Iron.—Filtration by Ascent.—Butter preserved without Salt.—Extemporaneous Yeast *.

THE Armenian jewellers set precious stones, particularly diamonds, to much advantage, with a foil, which, under roses or half brilliants, is remarkably beautiful, and is not subject to tarnish. Their method is as follows: An agate is cut, and highly polished, of the shape desired; in a block of lead is formed a cavity of about its own size; over this is placed a bit of tin, of the thickness of strong brown paper, scraped bright. The agate is then placed on the tin over the cavity, and struck with a mallet. The beautiful polish the tin receives is scarcely to be imagined. This is in general kept a secret, and such foils sell for half and three quarters of a dollar each.

The jewellers, who are mostly Armenians, have a curious method of ornamenting watch-cases and similar things, with diamonds and other stones, by simply glueing them on.

The stone is set in silver or gold, and the lower part of the metal made flat, or to correspond with the part to which it is to be fixed; it is then warmed gently, and the glue applied, which is so very strong that the parts never separate.

This glue, which may be applied to many purposes, as it will strongly join bits of glass or polished steel, is thus made:

Dissolve five or six bits of mastic as large as peas, in as much spirit of wine as will suffice to render it liquid; in another vessel dissolve as much isinglass (which has been

* From Eaton's Survey of the Turkish Empire, octavo. London 1798.

previously

previously soaken in water till it is swollen and soft) in French brandy or rum, as will make two ounces by measure of strong glue, and add two small bits of gum galbanum or ammoniacum, which must be rubbed or ground till they are dissolved; then mix the whole with a sufficient heat; keep it in a phial stopt, and when it is to be used set it in hot water.

A remarkable instance occurred to my knowledge of an individual fact which might have been of the utmost use to society, but which, owing to the state of knowledge and government in Turkey, was wholly lost to the world. An Arabian at Constantinople had discovered the secret of casting iron, which, when it came out of the mould, was as malleable as hammered iron. Some of his fabrication was accidentally shewn to Mr. de Gaffron, the Prussian chargé d'affaires, and Mr. Franzaroli (men of mineralogical science), who were struck with the fact, and immediately instituted an enquiry for its author. This man, whose art in Christendom would have insured him a splendid fortune, had died poor and unknown, and his secret had perished with him! His utensils were found, and several pieces of his casting, all perfectly malleable. Mr. Franzaroli analysed them, and found that there was no admixture of any other metal. Mr. de Gaffron has since been made superintendant of the iron manufactory at Spandau, where he has in vain attempted to discover the process of the Arabian.

I have seen practised a method of filtering water by ascension, which is much superior to our filtering stones or other methods by descent, in which in time particles of the stone or the finer sand make a passage along with the water.

They make two wells from five to ten feet, or any depth, at a small distance, which have a communication at bottom. The separation must be of clay well beaten, or of other substances impervious to water. The two wells are then filled with sand and gravel. The opening of that into which the water to be filtered is to run, must be somewhat higher than that into which the water is to ascend; and this must not have sand quite up to its brim, that there may be room for the filtered water, or it may, by a spout, run into a vessel placed for that purpose. The greater the difference is between the height of the two wells, the faster the water will filter; but the less it is the better, provided a sufficient quantity of water be supplied by it.

This may be practised in a cask, tub, jar, or other vessel. The water may be conveyed to the bottom by a pipe, the lower end having a spunge in it, or the pipe may be filled with coarse sand.

It is evident that all such particles, which by their gravity are carried down by filtration by descent, will not rise with the water in filtration by ascension. This might be practised on board ships at little expence.

The butter which is mostly used in Constantinople comes from the Crim and the Kuban. They do not salt it, but melt it in large copper pans over a very slow fire, and scum off what rises; it will then preserve sweet a long time if the butter was fresh when it was melted. We preserve butter mostly by salting. I have had butter which, when fresh, was melted and scummed in the Tartan manner, and then salted in our manner, which kept two years good

good and fine tasted. Washing does not so effectually free butter from the curd and butter-milk, which it is necessary to do in order to preserve it, as boiling or melting; when then salt is added to prevent the pure butyrous part from growing rancid, we certainly have the best process for preserving butter. The melting or boiling, if done with care, does not discolour or injure the taste.

The preservation of yeast having been a subject of much research in this country, the following particulars may perhaps deserve attention:—On the coast of Persia my bread was made, in the English manner, of good wheat flower, and with the yeast generally used there. It is thus prepared: Take a small tea-cup or wine-glass full of split or bruised pease, pour on it a pint of boiling water, and set the whole in a vessel all night on the hearth, or any other warm place; the water will have a froth on its top next morning, and will be good yeast. In this cold climate, especially at a cold season, it should stand longer to ferment, perhaps twenty-four or forty-eight hours. The above quantity made me as much bread as two sixpenny loaves, the quality of which was very good and very light.

VIII.

Observation of the Passage of a Comet over the Disk of the Sun. By Citizen Dangos.

On the 18th of January 1798, Dangos observed a black, round, and well terminated body, which crossed the disk of the sun. The time of its passage lasted 20 minutes. He thinks it could be nothing but a comet. He recollects having observed a similar phenomenon in 1784.

Lalande remarks, that Mercury and Venus have been well observed crossing the solar disk in the form of black spots; but that comets had never been in that situation *.

* This notice, which is taken from the Journal de Physique for February 1798, leaves much to be desired. What might be the diameter of the spot; whether its course was direct or retrograde, with its inclination to the ecliptic, or to the solar axis; and particularly the chord it described; are objects of enquiry, concerning which we shall probably learn more in future, when a fuller account shall appear. If we admit that it was a comet, and, by way of obtaining a rough notion or guess of its distance, we suppose it to have described a whole diameter of the sun, we shall, from the time and the angular space, deduce, that it was about seventy times nearer the sun than our planet. This, on the supposition of its being near the perihelion, which however is mere supposition, would rank it among those comets which approach the nearest to that luminary. (See a Table of the elements of a considerable number of comets in Pingre's Cometographie, which is copied into Hutton's Dictionary, article Comet.)

If we consider how very seldom the inferior planets, Venus and Mercury, cross the sun, notwithstanding their short periods, and the little inclination of their orbits, it will be less surprising that the comets, though very numerous, should not often be found together with the earth in the line of their nodes; or that an unforeseen event, of such short duration, should scarcely ever meet the eye of the astronomer. N.

IX.

Analysis of the Aqua-marine or Beryl; and the Discovery of a new Earth in that Stone. Read before the French National Institute 26 *Pluviose, in the Year VI.* (*Feb.* 14. 1798.) *By Citizen* VAUQUELIN *.

Section I. Introduction.

THE analysis of minerals is one of those operations which are usually considered to be of little importance, and are submitted, by chemists of the first order, as unworthy of their care, to the manipulation of their pupils.

I am well aware that the greater number of analyses afford results of little importance, which do not repay the labour and the time bestowed in obtaining them. I am likewise aware that they do not offer so brilliant a prospect, nor promise to afford results of so general a nature, as the plan of operation which has been formed with regard to some of the most important points in chemistry. But I am not, from these reasons, of opinion, that this class of processes, which has likewise its difficulties, and requires, for its successful conduct, a certain series of reasoning, and particularly an exact knowledge of the bodies described ;—I am not of opinion that it is so little entitled to engage the attention of philosophical chemists. For they must recollect, that it has afforded them the solid foundation of their theories, and new objects for the exercise of their abilities.

From a disregard of this kind it was that Bergmann, whose active mind could not submit to the details of experiment, has committed so many faults, by trusting his operations to young pupils, who had not acquired the habit of distinguishing new substances from those which were already known.

The analysis of the beryl, already made by Bindheim, will be a proof of what I here advance. It is composed, according to him, of silex 64, alumine 27, lime 8, and iron 2.

Citizen Hauy having found a perfect agreement between the structure, hardness, and weight of the beryl and the emerald, engaged me, some months ago, to compare these two stones by chemical means also, in order to know whether they were composed of the same principles in similar proportions.

The most interesting circumstance to the Institute in this result being a new earth, which I have discovered in the beryl, I shall pass slightly over the other objects, and dwell more particularly on its distinctive properties.

Section II. The Method of Analysis.

Experiment 1. One hundred parts of beryl reduced to fine powder were fused with 300 parts of caustic potash ; the mass, after cooling, was diffused in water, and treated with the muriatic acid : by this means the solution was completed.

The muriatic solution was evaporated to dryness ; towards the end of the evaporation the fluid assumed the form of a jelly : the dried matter was then diffused in a large quantity of water. Part of the matter was dissolved ; but a white, granulated transparent powder remained. This substance, collected on a filter, washed with much water, and dried by ignition, weighed 69 parts. It had all the properties of silex.

* Annales de Chimie, xxvi. 155.

Experiment

Experiment 2. The fluid ſeparated from the ſilex was precipitated by the carbonate of potaſh of commerce; the precipitate collected and drained was treated with a ſolution of cauſtic potaſh. The greateſt part of the matter was diſſolved; but there remained a certain quantity of earth which was not taken up. This being ſeparated, waſhed, and dried by ignition, was of a brown greyiſh colour; it weighed nine parts. In theſe nine parts it is that our new earth is contained. We ſhall ſpeak of it again in the ſubſequent part of this Memoir.

Experiment 3. The alkaline ſolution of the foregoing experiment was ſuper-ſaturated with muriatic acid, until a perfect ſolution took place, and this was again precipitated by the carbonate of potaſh of commerce: the depoſition, waſhed and dried by a red heat, weighed 21 parts.

This ſubſtance appeared to me at that time to be pure alumine. We ſhall ſee what concluſion ought to be made, after examining the properties of the new earth which I have announced.

Experiment 4. The nine parts in *Experiment* 2. remaining after the action of the potaſh, and in which I announced the exiſtence of a new earth, were diſſolved in the nitric acid; the ſolution was evaporated to dryneſs, and the reſidue again diſſolved in water. The ſolution of this ſubſtance having aſſumed a reddiſh yellow colour, which indicated the preſence of iron, a ſolution of the hydro-ſulphuret of potaſh was mixed with it; a black voluminous precipitate was formed; the fluid was heated in order to favour the union of the parts, after which the fluid was decanted clear and colourleſs. The black precipitate by calcination became of a red brown colour, and weighed one part. When diſſolved in the muriatic acid, and the ſolution evaporated to dryneſs, it afforded a beautiful blue when an atom of the matter was thrown into a ſolution of the Pruſſiate of potaſh: it was therefore the oxide of iron.

The fluid from which this oxide had been ſeparated was again evaporated to dryneſs; and though at firſt it had no colour, it nevertheleſs became red towards the end of the proceſs, and the reſidue preſerved that colour. This reſidue having been left for 24 hours in a capſule, became reduced into a kind of gelatinous fluid, of a yellowiſh red colour: cold water poured thereon diſſolved the whole maſs; but the ſolution was red and turbid: by expoſure on the heated ſand-bath, red flocks were ſeparated, and the fluid became as clear as water. Theſe flocks, carefully ſeparated, waſhed and dried, weighed half a part: it was alſo the oxide of iron; which, with the part before obtained by means of the hydro-ſulphuret of potaſh, makes one part and a half of that ſubſtance.

Experiment 5. The earth being thus perfectly deprived of the oxide of iron, I ſeparated it from the nitric acid by means of the common carbonate of potaſh; and I obtained 12 parts of a white earth, ſoft beneath the fingers, and ſoluble in acids with efferveſcence.

We ſee that this earth, in its ſeparation from the nitric acid, did abſorb four parts and a half of carbonic acid; ſince out of nine which were ſubjected to experiment, one and a half of the oxide of iron were obtained; which leaves 7,5 for the earth contained in the 12 parts of carbonate laſt precipitated.

Section III. Exposition of the Properties of the new Earth contained in the Beryl.

Experiment 1. The 12 parts of earth united with carbonic acid, as before mentioned, were put into sulphuric acid, which dissolved them completely with effervescence. The solution had a very saccharine taste at first, and astringent at last. The solution left till the following day afforded irregular crystals, very solid and saccharine like the solution which afforded them.

Experiment 2. These crystals were again dissolved in water; the solution mixed with sulphate of potash did not afford alum either immediately nor by evaporation, as happens in the alumine when combined with the sulphuric acid. Each of these salts crystallizes separately, without contracting any union.

I repeated this operation five times in succession, with different doses of sulphate of potash, without obtaining more succees than at first. At last, to convince myself of the difference between this earth and alumine, I took equal quantities of the one and the other; and after having dissolved them in the sulphuric acid, I mixed them with like quantities of sulphate of potash. I constantly obtained octahedral alum with the alumine; but the earth of the beryl afforded only an irregular salt.

These differences first discovered between the two earths, induced me to seek for others, by comparing them in a greater number of points.

Section IV. Comparison of the Properties of the Earth of Beryl with those of Alumine.

Experiment 1. For this purpose, I separately dissolved equal quantities of alumine and of the earth of beryl in nitric acid, to perfect saturation.

The salt which arose from the combination of the earth of beryl with the nitric acid, did not appear susceptible of crystallization; it strongly retains moisture; by desiccation it becomes converted into a kind of ductile paste, which, when exposed to the air, powerfully attracts moisture. Its taste is at first very sweet, and afterwards astringent.

Experiment 2. The nitrate of alumine likewise crystallizes with considerable difficulty; but it does not attract moisture so strongly. Its taste is not saccharine, like that of the nitrate formed with the earth of beryl.

I made the following comparative essays of the solutions of these two salts, using equal quantities of each.

1. The nitrate of alumine, mixed with a solution of nut-galls in alcohol, afforded no precipitate. The fluid simply acquired a slight greenish colour, and lost somewhat of its transparence; however, at the expiration of some hours, the fluid, having been diluted with water, let fall a greyish precipitate.—2. The salt of the earth of beryl, mixed with the same re-agent, immediately afforded a deposition in flocks of a yellow brown colour.

3. The nitrate of alumine, mixed with the oxalate of potash, immediately afforded a precipitate in the form of very abundant white flocks, which subsided to the lower part of the vessel, and left the superior fluid perfectly clear.—4. The salt of the earth of beryl, with the same re-agent, did not afford the slightest appearance of a precipitate, even after several days.

5. The

5. The nitrate of alumine, mixed with tartrite of potash, immediately formed a deposition in flocks, and the super-natant liquor became clear and colourless.—6. The salt of the earth of beryl, with the same re-agent, did not produce any sign of precipitation after several days.

7. The nitrate of alumine, mixed with a solution of the phosphate of soda, afforded a gelatinous semi-transparent precipitate, which subsided very slowly.—8. The salt of the earth of beryl also formed a precipitate with the same re-agent; but it was less gelatinous, and less transparent, and it also fell down more speedily.

9. The nitrate of alumine, mixed with very pure Prussiate of potash, instantly afforded a very abundant whitish precipitate, which became green at the end of a few hours.—10. The salt of the earth of beryl, with the same re-agent, afforded no precipitate, even after several days.

11. The nitrate of alumine, mixed with a saturated solution of potash, afforded a gelatinous magma, which was semi-transparent, and soon became filled with numerous bubbles of gas, which raised it to the upper part of the fluid.—12. The salt of the earth of beryl, mixed with the same re-agent, afforded a precipitate in flocks, which was not filled with bubbles like the foregoing, and which fell to the bottom of the liquid.

13. The nitrate of alumine, mixed with a solution of caustic potash, at first afforded a gelatinous deposition, which was afterwards taken up by the excess of alkali.—14. The salt of the earth of beryl, treated with the same re-agent, was affected in the same manner, excepting only that a larger quantity of alkali was required for the second solution.

15. The nitrate of alumine, mixed with a solution of carbonate of ammoniac, formed a precipitate which was not re-dissolved by an excess of alkali.—16. The salt of the earth of beryl, mixed with the same re-agent, afforded a precipitate which was entirely re-dissolved by an excess of alkali.

We see by most of these experiments, that the earth of beryl essentially differs from alumine, which however it resembles much more than any other earth, and with which it may even be easily confounded in certain respects.

But the experiment which induced me to fix my opinion irrevocably with respect to this earth, was that which shewed the comparative degree of attraction of the two earths for the same acid.

To acquire this knowledge, I dissolved in the nitric acid twelve parts of very pure alumine, and evaporated to dryness, in order to expel the surplus of acid which was in the fluid. The residue being dissolved in water, I added to the solution ten parts of the earth of beryl, recently precipitated from its solvent, well washed, and still moist.

I added no more than ten parts of the earth of beryl, to precipitate the twelve parts of alumine, though I had ascertained, by other experiments, that a somewhat greater quantity of the earth of beryl than of alumine was necessary to saturate the same quantity of acid; but I chose rather that a small quantity of alumine should remain in solution, than that any portion of the earth of beryl should mix with the precipitate. When therefore the mixture had thus been made, I boiled the fluid for a quarter of an hour, then filtered it, and retained on the filter the earthy precipitate. After washing this, I combined it with the sulphuric acid, and evaporated to dryness, in order to expel the excess of acid; after which, re-dissolving

re-dissolving it in water, I added a few drops of sulphate of pot-ash to the solution, and obtained octahedral crystals of alum.

Now it is evident that the earth of beryl has more affinity with the nitric acid than alumine has, and consequently that it is not the same earth. If the earth of beryl be not alumine, there is much greater reason to decide, that it is not one of the other known earths; for it differs much more from them than from alumine. I therefore consider this earth as a new substance, different from all those we are yet acquainted with. It is true, that it in some measure resembles alumine, namely, in its softness to the touch, its adhesion to the tongue, its levity, its solubility in pot-ash, and its precipitation from its solutions by ammoniac. But it differs from alumine in its other properties. Its combinations with acids have a very saccharine taste; it has a stronger affinity with those solvents; it does not afford alum with the sulphuric acid and potash; it is totally soluble in carbonate of ammoniac; and lastly, it is not, like alumine, precipitable from its solutions by the oxalate and the tartrite of pot-ash.

This earth being soluble in caustic pot-ash, like alumine, we can no longer trust to this simple character to ascertain the presence of the latter earth; for it may happen that the earth of beryl should be taken for alumine, or a mixture of both for one or the other of these pure earths. It will therefore be necessary, whenever an earth soluble in pot-ash is found, to endeavour to convert it into alum by the known methods. If it do not afford alum, it may be certainly concluded that it is not alumine. But it may possibly afford alum, and nevertheless contain the earth of beryl; a mother water will then remain, in which this last earth will be suspended.

To separate the small quantity of alum, which likewise remains in this mother water, it will be proper to decompose it by a solution of the carbonate of ammoniac added in excess; by this means alum will be entirely precipitated, and the earth of beryl will remain dissolved in the carbonate of ammoniac. This earth may afterwards be readily separated, by boiling the solution for a certain time. The heat will drive off the carbonate of ammoniac, and the earth will fall down in the form of a powder.

By comparing the results of the analysis of the beryl with those which Klaproth and myself obtained from that of the emerald, we might conclude, that these two stones are very different from each other; for I found that the emerald was composed of 64 of silex, 29 alumine, 2 lime, between 3 and 4 of the oxide of chrome *, and 1 or 2 of water; whereas the beryl is composed of 69 silex, 21 alumine, 8 of the peculiar earth, and $1\frac{1}{2}$ of the oxide of iron.

But since that time I have found that the emerald likewise contains this new earth; whence it follows, that the emerald and the beryl are one and the same substance, differing only in their colouring matter.

With regard to the proportion in which I have obtained this earth of the beryl, I do not give it as strictly accurate; for it is possible that part may have been dissolved at the same time as the alumine by the pot-ash †.

* This is the metallic acid discovered in the red-lead of Siberia, of which a short account was given in our Journal, II, 145. The memoir at length, with additional information, will appear in our next. N.

† Since the above was written, I have ascertained, that there was in fact a certain quantity of the earth of beryl dissolved by the pot-ash with the alumine; and that instead of 8 per cent, the beryl contains 16.

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I have not yet thought it proper to give a name to this earth. I ſhall wait till its properties are better known; beſides which, I ſhould be glad to have the advice of my brother-chemiſts on the ſubject *.

In a ſecond memoir, I ſhall ſpeedily give the moſt complete account in my power, of its combinations with the acids and ſome of the combuſtible bodies †.

X.

Deſcription of a new-invented detached Eſcapement for Pocket Watches, &c. *By Mr.* JOHN PRIOR ‡.

FIG. 1 and 2, Plate XV, repreſent the principal parts of the eſcapement.

Fig. 1. A B, the pillar-plate; and A B E F, *fig.* 2, is a ſection of the frame without pillars or potance. C, the cock ſcrewed to the potance-plate at D. G, the balance, the lower part of which runs in the plate (but perhaps a potance will be more convenient for it in a pocket watch). H, the regulating ſpring, pinned faſt in the ſtud at I. O, the friction wheel. N, its arbor, the higher pivot of which runs in the collet the balance is rivetted to, and the lower in a collet ſcrewed faſt on the balance-arbor at P; ſo, when the balance turns round, the friction-wheel is taken along with it.

M, the intermittent lever-wheel. L, its arbor. R, its pinion, in the rim of which wheel are put an equal number of pins on each ſide. The pins on one ſide of the wheel are put exactly at the middle diſtance of thoſe on the other ſide.

T, the intermittent lever, ſcrewed faſt to K, its arbor. Q Q are its banking ſcrews.

The lever is all made of one ſolid piece of ſteel. That end of it next the wheel is cut open wide enough to receive the rim, without touching either ſide of it, as far as the pallets or inclined planes are; at the end of which it is cut wider, to admit the pins of the wheel. (See *fig.* 2, a ſection of it as under L.)

The diſtance from the centre of the balance to the extreme part of the lever, or end of the pallets, is divided in a right line into ten equal parts, and the pivot-hole of the friction-wheel is made at the firſt tenth diviſion from the centre of the balance. There are thirteen ſemi-diameters of the friction wheel from its centre to the end of the pallets.

When the balance is at reſt, then the centre of the balance, the centre of the friction-wheel, and the centre of the lever, will be all in one right line. (See *fig.* 1.)

The lever is divided into three equal parts. The diſtance from the end of the pallets to

* The moſt characteriſtic property of this earth, confirmed by the lateſt experiments of our colleague, being, that it forms ſalts of a ſaccharine taſte, we propoſe to call it Glucine, from γλυκυς ſweet, γλυκὺ ſweet wine, γλυκαινω to render ſweet. This denomination will be ſignificant enough to aſſiſt the memory; it does not derive its etymology from a ſenſe too ſtrictly determined; neither does it preſent ideas falſely excluſive, like thoſe names which might be taken from the name of the ſtone which afforded the firſt ſpecimen of the new ſubſtance, the name of the firſt village where it was met with, &c. &c. Theſe, we apprehend, are the true principles for the advancement of ſcience, and facilitating its ſtudy, by means of nomenclature. Note of the Editors of the Annales.

† Cit. Vauquelin has publiſhed an appendix to this paper, on the general properties of this earth, which will appear in our next. N.

‡ Tranſactions of the Society for the Encouragement of Arts, 1798. A premium of thirty guineas was given to the inventor. N.

the

the centre of motion of the lever, one part; and from the centre of motion to the centre of the friction-wheel, when the balance is at rest, two parts: so that, whatever the velocity may be at the end of the pallets when in motion, that part of the lever, or the forked part of it, which is opposite the centre of motion of the friction-wheel, will be twice as much.

S S represents a superficial view of the pallets. The pallet below the pillar-plate is taken off from the other, otherwise the place of action could not be seen in the drawing.

In *fig.* 1, we have a view of the lever before the machine is wound up: a pin is half-way down the pallet; but when the pin impels the pallet, the lever moves, and gives motion to the balance, and the pin is disengaged from the pallet at the angle: that instant a pin, on the opposite side of the wheel, falls upon a circular part of the end of the other pallet, or upon that part where it and the lever are entirely at rest, until the balance makes its return, and the friction-wheel comes into the forked end of the lever. Then the friction-wheel impels the lever, while the balance runs over the space of about one hundred degrees. Then the pin drops off at the end of the pallets as before, and the balance is entirely left at liberty; at which time its velocity is so great, and its motion so easy, that it turns once round upon its pivots, and two hundred and forty degrees every vibration.

It is to be observed, that, in the ends of the fork, one part is turned up and the other down, in order they may not both go through one notch in the balance arbor; for, by having two different parts cut away, the fork is locked fast in every vibration, and is unlocked only by the friction-wheel in its return for another vibration.

Notwithstanding the balance makes one turn and two hundred and forty degrees every vibration around its axis, yet, when the balance is at rest, and the same power applied to it (which keeps it in motion as above), the balance will only move through the space of about fifteen degrees, which is only one fortieth part it keeps it up to when in motion.

It must be allowed, the less the wheels, or the power, have to do with the balance, the more accurate the time will be shewn *.

XI.

On Mr. CARTWRIGHT's Invention for rendering the Pistons of Steam Engines, Pumps, and other Hydraulic Apparatus tight by metallic Parts, without packing or leathering. (W. N.)

To MR. NICHOLSON.

SIR, Richmond, Oct. 10. 1798.

I HAVE lately been informed, that a new method of packing steam engines has been invented by a Mr. Cartwright, which is said to be particularly advantageous in saving friction and resisting an heavy column of water in pumps. I shall be very glad to see a description of the same in your Journal, with your opinion of its effects, &c.

Your constant Reader,

A. R.

* Artists will perceive that this is an improvement of the anchor scapement of Mudge, of which the inventor was not aware till he came to London. In this the pallets exactly resemble those of Graham's dead beat (Philos. Journal, II. 52.), and a tail acts against two planes in the axis of the balance. Pallets like those of Mr. Prior were adapted to a long pendulum by Mr. Crosthwaite of Dublin, in the year 1788, (Memoirs of the Irish Acad. vol. II.) and since that time also by other persons in London. N.

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THE contrivance to which my correspondent refers, is part of a steam engine, for which a patent has been taken out. It is generally understood that in practice it is necessary to apply the packing close round the piston of a steam engine, in such a manner as to make it act strongly against the sides of the cylinder, which must occasion a considerable degree of friction: and when it has worked loose, it may be concluded that some loss of force must follow, from the escape of elastic fluid between the surfaces intended to be in contact. A similar observation may be applied to the usual leathering of pumps, in which the friction is very great, and the resistance to severe pressure very far from being effectual. Early in the present century, a contrivance was made by a Mr. Haskins to prevent friction, by substituting quicksilver instead of leather; which, for several statical reasons, and also, as I suspect, from some of a chemical nature, could not be brought into general use. The reader may see a very full description of this engine, in Desaguliers's Course of Experimental Philosophy, II. 491.

Mr. Cartwright's invention consists in using solid masses of metal instead of the packing or leathering; which, by means of springs, adapt themselves to the variations of diameter in the cylinder, and, by their mode of application above each other, are expected to prevent that escape of fluid which would else take place through the intervals between the several pieces. Imagine the piston to consist of a circular plate of metal, nearly equal in diameter to the cylinder in which it is to move. It will make no difference in the general consideration of our subject, whether this piston have a valve in it or not. Upon the upper surface of this piston are laid three or more pieces of metal, which all together compose a flat circular ring; the ends of the several pieces nearly touching each other. A very moderate portion of mechanical knowledge will suggest the manner in which these pieces might be made to recede outwards, by means of springs; so as to occupy the circumference of a greater circle externally, than that to which they would nearly correspond when regularly pressed inwards. If the piston in this situation be placed in its cylinder, it is evident, that the pieces composing the ring will be forced against the concavity; which, if of the proper curvature, they will fit, and prevent any fluid from passing through, except at the interstices, where the ring is rendered incomplete by being divided into parts. To remedy this, a second ring is laid upon the first, with its joints half-way between the joints of the former, in the same manner as we every day observe in courses of brick-work. This second ring, being urged outwards like the first, performs the same function; but any fluid that may pass downwards through the interstices of the upper ring, will be stopped by the contiguous parts of the lower; and, on the contrary, whatever fluid may pass upwards through the interstices of the lower ring will, for the same reason, be stopped by the upper.

From this description it is sufficiently clear, that Mr. Cartwright is entitled to much praise for the ingenuity and acuteness displayed in his contrivance. The practical value of that contrivance, respecting which I am requested to state the facts, will probably be ascertained from the following considerations:

In the usual stuffing or leathering, the elasticity of the organized matter made use of is supposed to act, in each individual part, so far independently, that, if there be an irregularity in the cylinder by variation of its curvature or magnitude, this irregularity will be followed up and fitted by the elastic material. But Mr. Cartwright's metallic packing possessing a determinate curvature, will fit only when the zone with which it is in contact possesses the same

ſame curvature. If his piſton be preſſed into a ſmaller cylinder than correſponds with the actual circle his pieces are adapted to form, thoſe pieces will be preſſed in, and will touch only at their extremities; ſo that every joint will be immediately over a place where the oppoſite ring does not in fact touch the cylinder: it will therefore, in this caſe, leak principally at the joints. And, on the contrary, if his piſton be preſſed into a larger cylinder than correſponds with the circle of the rings, each portion of thoſe rings will touch the cylinder in one point only. The moſt favourable point will be at the half-way between the extremities of each piece. In this poſition the joints indeed will not leak, but every other part of the circumference will; and the places of the moſt open paſſage will be at thoſe points of the circumference which are equidiſtant between joint and joint. Theſe conſiderations relate to perfect circles; but if we attend to ſmaller irregularities, whether convexities or concavities in the cylinder, it appears evident, that the ſegments of the rings being inflexible will ſtill leſs effectually adapt themſelves to ſuch imperfections.

Theſe objections, relating to the figure of the periphery of this metallic piſton, are of very ſerious import: thoſe which relate to its action are ſcarcely leſs ſo. The ſurfaces of the rings thus laid upon the piſton and upon each other, together with the ſurface of the piece which confines them from riſing, muſt all be very well adapted to each other; and the number of ſquare inches of this ſurface muſt, in the nature of the contrivance, be conſiderable enough to afford much friction. It may reaſonably be doubted whether theſe pieces, in the rapidity of aſcent and deſcent, can obey the action of the ſprings during the very ſhort times in which the pieces are oppoſed to the irregularities they are meant to remedy. But when a great preſſure, ſuch, for example, as the reaction of a column of 100 feet of water, comes to be exerted upon the face of this apparatus, the plates or pieces of theſe rings may be imagined to be confined in a vice. The preſſure of ſuch a column will amount to more than 40 pounds upon every ſquare inch. Whence we may conclude, either that they would not move at all, or that the force of the ſprings muſt be ſuch as greatly to load the work with friction, and damage the apparatus by ſpeedy wear.

Laſtly, it ſeems to be a queſtion or doubt, which well deſerves to be reſolved by further experiment, whether, in any caſe of reiterated or long continued action, the ſofter metals can be made to work in contact with each other, in the way of cloſe fitting, with as little reſiſtance and wear as when an organiſed ſubſtance containing oil or fat is interpoſed.

When one individual ſpeaks to the world concerning the works of another, the tranſaction is naturally accompanied with a ſenſe of perſonality. As this ſenſe ought not to lead men into unworthy actions, ſo, on the other hand, it ought not to prevent their fulfilling any duty which may call upon them. Convinced that no vindication or apology is neceſſary in defence of a ſcientific examination of every object which is offered to the public acceptance, I have ſpoken freely of a conſtruction which, from its ingenuity, might be thought of greater value than it really is; but which, when carefully examined, appears to be inferior to the methods already in uſe.

XII.

Information respecting the Zoonic Acid, discovered by BERTHOLLET.

THE fluid * obtained by distillation from animal substances has been hitherto thought to contain no other principle than carbonate of ammoniac and an oil. Berthollet has ascertained that it contains an acid, to which he has given the name of zoonic acid. He has ascertained its presence in the fluid obtained from the gluten of wheat, the yeast of beer, bones, and woollen rags, distilled for the preparation of the muriate of ammoniac; and he thinks himself authorized to consider it as the product of distillation of all animal substances.

In order to separate this acid, he mixes lime with the fluid afforded by this destructive distillation, after having separated the oil. The mixture is then boiled or distilled, to separate the carbonate of ammoniac. When the odour ceases to be penetrating, he filters and adds a small quantity of lime to the liquid, which he again boils till the odour of ammoniac has entirely disappeared. What remains is the zoonate of lime, which he again filters. To this he then adds the aqueous solution of carbonic acid, or otherwise he blows through a tube into the liquor, in order to precipitate any lime which might exist in the uncombined state. The zoonate of lime may then be used to produce other compounds by double affinity; or the pure zoonic acid may be had by the following process:

The well concentrated aqueous solution of zoonate of lime is to be mixed with phosphoric acid, in a tubulated retort, and exposed to distillation. The zoonic acid is not very volatile, but requires a degree of heat nearly equal to that of boiling water to raise it. The fluid must therefore be boiled; and if two successive receivers be at the same time adapted, it will not be driven into the second. Part of the acid seems to be destroyed by the action of the heat; for the liquor becomes brown by the ebullition, and towards the end of the process black: whence it may be concluded that this acid contains carbone. Berthollet did not examine the other principles which are disengaged during the decomposition.

The zoonic acid has a smell resembling meat which has been roasted; a process in which it is indeed formed. Its taste is austere, and, from the few experiments of Berthollet, no remarkable properties were exhibited. It strongly reddens paper tinged with turnsol, and effervesces with alkaline carbonates. It did not appear to him to afford crystallizable salts with earths or alkaline bases. It afforded a white precipitate in the aqueous solution of acetite of mercury, and in that of nitrate of lead; so that it has a stronger attraction to the oxydes of mercury and lead respectively than the acetous and nitric acids. It does not act on the nitrate of silver but by double affinity. The precipitate which then falls down becomes brown in time, and therefore contains hydrogen. The zoonate of potash calcined did not afford prussiate of iron with a solution of that metal. A liquid, possessing all the characters of acidity, was separated from flesh, which Berthollet had kept a long time in a state of putrefaction; but it was an ammoniacal salt with excess of acid. This acid, combined with lime, appeared to him to resemble the zoonate of lime; but the quantity he had was too small to admit of its identity with the zoonic acid being accurately determined.

* Nearly in the words of Berthollet, in the Annales de Chimie, xxvi. 86.

XIII.

Historical Notes concerning the Invention of the Air Pump with Metallic Valves; the Necessity of Alkali to produce the crystallized Salt called Alum; and the electrical Instrument known by the name of the Revolving Doubler. (W. N.)

CITIZEN ADET, in vol. xxv. of the Annales de Chimie, p. 165, claims the invention of an air-pump for Cit. Ami Argand, at Paris, in the year 1776, of which that of Cuthbertson is said to be an imitation. Reference is made to the notes on the third volume of the *Leçons Elémentaires de Physique, de Sigaud de la Fond*, for a description.

I am happy in this opportunity of doing honour to a philosopher and mechanic, with whose ability I am well acquainted. That tenacity with regard to the credit arising from first thoughts or inventions, and the partiality which leads men to exult in the nationality of discovery, are estimable qualities on the whole, because they tend to the promotion of science; but they sometimes lead to insinuations of *mala fides* in cases where the coincidences of reasoning have alone produced similar results. On this occasion it seems proper to remark, that Mr. Cuthbertson has candidly displayed the source from which he derived his information, and that, upon the whole, it appears highly probable, as well from the respectable characters of the individuals, as from the general circumstances of the case, that this artist, as well as Paets van Trooftwyk, Dr. Rutherford, and Sir George Mackenzie, would have done justice to the invention of Mr. Argand, if they had been acquainted with it *.

In the same Annales, xxiii. 222, there is a claim on the part of the celebrated Chaptal respecting the discovery of the nature and triple composition of alum, communicated to the Institute by Vauquelin †. To which this last chemist has answered, in vol. xxv. p. 107, that he was unacquainted with the labours of Chaptal in that respect, and had communicated his own memoir to the Institute a fortnight before Cit. Chaptal's memoir arrived; and, lastly, that the priority and merit of the discovery belong to Cit. Descroisilles, whose researches concerning the nature of alum were published by Berthollet, in his Art of Dyeing, long before that time.

Another instance in which I am in some degree concerned, affords a curious example of the slowness with which the improvements of philosophical apparatus are in some cases communicated. In the 22d number of the Bibliotheque Brittannique, there is an account of the doubler of electricity of *John Read*. The process of accumulating electricity ‡ by doubling, was invented by Lichtenberg and Klincock, and greatly improved by Bennett, who applied it to Volta's condenser. In 1787, Dr. Darwin constructed a machine for performing the process in part mechanically; and in 1788, I made and communicated to the Royal Society the Revolving Doubler by which the whole act is reduced to the simple turning of a winch. Five years afterwards, namely in 1793, Mr. John Read published his " Summary View of Spontaneous Electricity, &c." in the 4th chapter of which he

* On this subject, see our Journal, II. 28.

† Philos. Journal, I. 318.

‡ Philos. Journal, I. 396.

gives

gives a defcription of my inftrument in my own words, copied without acknowledgment from the Philofophical Tranfactions for 1788, but difguifed in a fmall degree by a new denomination in the title, and an unneceffary lengthening of the infulating parts, which before were upwards of ten times the length of the interval between plate and plate. It is evident, therefore, that of all the individuals who have written on this inftrument, the credit of the invention has, in 1798, been beftowed on the perfon who has the leaft claim to philofophical invention or candid narrative.

XIV.

Defcription of an Apparatus for faturating Pot-afh and Soda with Carbonic Acid. By Citizen WELTHER *.

THE intention of this apparatus is, to afford an uninterrupted contact between the alkali and the carbonic acid gas, and to proportion the difengagement of the gas to its fixation.

Fig. 1. *plate* XVI. reprefents the complete apparatus. It is compofed of four diftinct parts, A, B, C, D. The firft, A, ferves for the difengagement or production of the carbonic acid gas, whence it is diftributed into the apparatus. The fecond, B, connects all the feveral parts of the apparatus together. The third, C, is the refervoir for carbonic acid gas. The principal function of this part is to fupply gas to the alkali in proportion as the abforption takes place. And the fourth, D, contains the alkali which is to be faturated, in contact with the carbonic acid.

Each of thefe parts requires a particular defcription.

The part A, confifts of a bottle with two necks *a*, *b*, (the third, *c*, is not neceffary). This bottle contains fulphuric acid diluted with four parts of water, to the height *d*.—The neck *a*, receives a tube *e′ e′ e*, of which the upper part *e′ e′*, diverges like the bafe of a funnel, and the lower part *e*, which paffes through the cork and enters the bottle, is drawn out by the lamp, in fuch a manner, that the portion of tube which is in the ftopper has the fame internal diameter as the extremity *g* of the ftem *f*, reprefented *fig.* 2, A; and that the orifice *e* within the bottle, is only two millimetres in diameter ($\frac{1}{25}$ of an inch) †. Into the tube *e′ e′ e* enters the ftem or ftick of glafs *f*, reprefented *fig.* 2, A, the lower extremity of which is bound with flax, fo that it ferves as a ftopper in the contracted part of the tube, and does not permit its contents to flow into the bottle *a*, unlefs that ftopper be raifed.—The neck *b* contains a tube *h h h* bended into two angles, and forming a communication between A and B.

The part B, confifts of a bottle with five necks *a b f i h*, of which the plan is reprefented *fig.* 3, B. This bottle contains water as high as *l*.—The neck *h* receives the tube *h h h*,

* This apparatus was conftructed in the firft month of the third republican year. The defcription is tranflated from the Annales de Chimie, xxvii. 53.

† The tube *e′ e′ e* may be made out of a fmall matrafs with a long neck. The bottom may be taken away, leaving about half the body, which will form the part *e′ e′* of the tube; the neck will afford the part *a a*, and the extremity of the neck foftened and drawn out by the lamp to the above dimenfions, will afford the extremity *e*. W.

proceeding

proceeding from the bottle A.—The neck *b* contains a ſtrait tube *g g'*, whoſe extremity *g'* is plunged in the water to the depth of one or two centimetres (about $\frac{2}{5}$ of an inch.) It ſerves to ſhew the compreſſion to which the carbonic acid gas is ſubjected in the apparatus.—The neck *a* contains a ſtrait tube *a' a*, which allows a communication to be formed at pleaſure from the interior part of the bottle B, with the atmoſphere, by means of an apparatus of tubes ſhewn in *fig.* 4, B. The tube *a' a* has two ſtoppers at *m* and *n*: the ſtopper *m* enters the tube *m m*, encloſing the tube *a' a*; in the interval between theſe two tubes upon the ſtopper *m*, mercury is poured to the height *r* of twelve or fifteen millimetres (about $\frac{1}{2}$ an inch): the tube *a' a* is then covered by a third tube *d* cloſed above, which being immerſed at *p m* into the mercury, interrupts the communication of the atmoſphere with the orifice *a'* of the tube *a' a*, and conſequently cloſes the bottle B, when the ſtopper *n* is placed in the neck *a*.—The neck *i* contains a tube *i i*, compoſed like the former *a' a*; but of which the intermediate tube *o o o* twice recurved, eſtabliſhes a communication between the bottle B and the reſervoir C.—The laſt neck *f* contains a tube *f f f'*, twice recurved, which eſtabliſhes a communication between the bottles B and D.

The part C is compoſed of a tub *t*, in the ſide of which there is a hole at a ſmall diſtance above the bottom *a a*.—In this lateral hole is inſerted a perforated ſtopper, the interior orifice of which receives a tube *b b' b'' b*, bended into a right angle, of which the portion *b'* muſt be bended in ſuch a manner, that the angular part *b''* may touch the bottom *a a* of the tub, which renders it more firm in its poſition. In the external orifice of this cork, or ſtopper, there is ſcrewed a braſs cock *r*, of which the part *c* receives a tube *c c' c'' c*, bended at *c*, to riſe vertically, and from *c'* to *c''* to bind againſt the frame *d d*. This tube, at the height *d*, is compoſed like that of *a' a*, deſcribed *fig.* 4, B. It there receives the tube *o o o*, which affords a communication with B.—The pieces which are applied to the hole *b* of the tub, are luted; the inner with graver's wax, and the outer with fat lute.—In the tub *t*, containing water to the height *e e e*, there enters an inverted jar C, provided with a copper cock at *l* and *m*. This jar is ſuſpended at *g* by a ſtring, which paſſes over the pulleys *h h*, and ſupports at *i*, a weight K, ſomewhat leſs heavy than the jar itſelf, when entirely plunged in the water contained in the tub.—When the jar C is totally immerſed in the tub, it will reſt on two pieces of wood about two or three centimetres thick, which are fixed at *l l l* near the inner circumference of the bottom *a a* of the tub (ſee *fig.* 5, C, which repreſents the plan of the tub; and *fig.* 6, which repreſents the vertical ſection as far as A B), ſo that the baſe *l' l' l'* of the jar cannot touch the tube *b*.

The part D conſiſts of a bottle with three necks, *a*, *b*, *c*. The neck *a* receives a tube *a a' a*, proceeding to a ſmall bottle *d*, containing water as high as *e*.—The neck *b* receives the tube *f f f'* proceeding from the bottle B; this tube ought to poſſeſs a diameter of about two centimetres ($\frac{3}{4}$ of an inch) at its orifice *f'*.—The neck *c* contains a ſyphon *g g'*, communicating with the bottle *l*, of which the branch *g'* ought to be longer than *g*.—The bottle *l* has three necks, *h*, *i*, *k*.—It receives in its neck *i*, the ſyphon *g g'*; in the neck *k*, a tube *b b*, with one ſingle bend; and the neck *n* remains free. It is to be corked.

After the formation of the apparatus by uniting the four parts here deſcribed, each of them demands a particular preparation before the operation can be proceeded upon.

The tube *e' e' e* of the part A is to be filled with carbonate of lime mixed with water.—Through the neck *h* of the bottle *l*, in the part D, that bottle is to be filled with alkali. The

neck

neck *h* is then to be ſtopped with its cork, and by blowing through the tube K the alkali is to be forced through the ſyphon *g' g* into the bottle D. The air contained in this laſt bottle eſcapes through the tube *a a' a*, and paſſes through the water of the ſmall bottle *d*. The fluid becomes nearly on a level in the bottles D and *l*, and the extremity of the tube *f f f'*, which connects the bottles B and D, is plunged in the alkali.—Proceeding then to the part *c*, the cock *m* of the inverted veſſel is to be opened, while that of the tub *r* is kept ſhut. By the exceſs of weight of the jar beyond that of K it ſinks in the tub, and becomes filled with water, while the common air it contained eſcapes at *g*.—As ſoon as the inverted veſſel, being totally immerſed in the tub, repoſes on the circular ſegments *l l l*, the orifice of the upper tube of the tube *b* is found in the braſs receptacle *l*. It is neceſſary, that the level of the water, which by the immerſion of the inverted veſſel may have riſen from *e* to *e'*, ſhould have the elevation *be'* of the tube *b* equal at leaſt to two centimetres higher, in order that this tube may not be cloſed by the water, which would prevent the gas from entering into the veſſel C.—When this laſt veſſel is full of water, its cock *l* muſt be ſhut, and the cock *r* of the caſk muſt be opened.

In this diſpoſition of the apparatus, the glaſs ſtem *f* of the part A is to be raiſed, and carbonate of lime gradually introduced, which falling upon the ſulphuric acid becomes decompoſed, and loſes its carbonic acid. This laſt poſſeſſing the elaſtic ſtate, paſſes through the tube *h h h* into the bottle B. The tube *d* is then to be raiſed, in order that the atmoſpheric air contained in the bottles A and B may flow out; after which, the neck *a* of the bottle B is to be cloſed, by replacing tube *d*. In this ſituation the carbonic acid gas, which enters B, (meeting leſs reſiſtance in its paſſage to the inverted veſſel through the tubes *i i* and *o o o*, than to paſs into the part D by the tube *f f f'*, which is plunged in the alkali) raiſes and fills the veſſel *c*.—As ſoon as this event has happened, no more carbonate of lime is to be introduced into the bottle A, and the bottle D is filled with alkali by blowing through the tube K of the bottle *l*. The levels of the alkaline fluid are at the height *n* in the bottle D, and $m < n$ in the bottle *l*; and the fluid tending to its level, by means of the ſyphon *g g'*, the ſurface *n* falls, and produces a vacuum in the bottle D.—The carbonic acid gas is then drawn into the bottle D by the tube *f f f'*; at the ſame time that the water of the ſmall bottle *d* (part D) riſes in the tube *a a' a*; but the height of this tube is ſuch, that the carbonic acid gas can enter the bottle D before the water riſes to *a'* in the tube *a a' a*.—The two ſurfaces *n* and *m* acquire an equilibrium in the bottles D and *l*, and the carbonic acid gas, which occupies the upper part of the bottle D, combining with the pot-aſh, a vacuum is formed, which is continually ſupplied with new gas.—When the veſſel C is nearly exhauſted of its gas, it muſt be filled by a new diſengagement.

N. B. As the carbonic acid gas is mixed with a ſmall portion of atmoſpheric air, this air, which is not abſorbed by the pot-aſh, accumulates in the bottle D, and may ſtop the operation. It muſt be driven out by blowing into the tube *b* of the bottle *l*, and filling the bottle D with alkali.

XV. *Abſtract*

XV.

Abstract of a Memoir of KLAPROTH, *on a new Metal denominated Tellurium. Read at the Public Session of the Academy of Sciences at Berlin, January the 25th, 1798* *.

KLAPROTH, the chemist of Berlin, in the chemical analysis of the auriferous ore, known by the name of the white ore of gold (weiss golderz), aurum paradoxum, metallum vel aurum problematicum †, has discovered in that mineral, a metal absolutely different from all those which have hitherto been known, to which he has given the name of Tellurium, forming a kind of series or arrangement with the new metals discovered by him some time ago, and denominated Uranium and Titanium. Mr. Muller of Reichenstein, in the year 1782, had suspected the existence of a peculiar metallic substance in this mineral. Bergman, to whom he had forwarded a specimen of the ore, confirmed his suspicion; but on account of the small quantity upon which he operated, he did not think fit to decide, whether this fossil did actually contain a new metal, or whether it might not be antimony which he had mistaken for a new product. The numerous and ingenious experiments to which Klaproth has subjected a more considerable quantity of this ore, which was sent to him by Mr. Muller ‡, perfectly confirm the suspicions of that chemist, and of Bergman.

The Process for obtaining this Metal from its Ore.

1. A portion of the ore is gently heated, with six parts of muriatic acid; three parts of nitric acid are then to be added, and the mixture subjected to ebullition. A very considerable effervescence takes place, and the solution becomes complete.

2. The filtered solution is to be diluted with as much water as it can bear without becoming turbid, which quantity is very little. A solution of caustic pot-ash is then to be added, until the white precipitate, which is at first formed, shall disappear, and nothing but a brown deposition in flocks shall remain.

3. This last precipitate is a mixture of the oxides of gold and of iron, which may be separated by the usual methods.

4. To the alkaline solution (2), muriatic acid must be added, sufficient for the perfect saturation of the alkali; but not in excess. A white and very abundant precipitate is afforded, which, on the application of heat, falls to the bottom of the vessel in the form of a heavy powder. After washing and drying this precipitate, it is to be formed into a kind of paste, with a sufficient quantity of any fat oil; and this mass is introduced into a small glass retort, to which a receiver is loosely to be applied. In this disposition of the

* This abstract was communicated on the part of the author, by M. Rose, a chemist of Berlin, and was translated and forwarded to the Phylomatic Society at Paris, by L. Hecht the younger. The French translation, which of course I must follow (as the original is unpublished), is inserted in the xxvth vol. of the Annales de Chimie, p. 273.

† This mineral is found in the mine called *Mariahilf*, in the *Fatzbay* mountains near *Zalethna* in *Transilvania*. See Emmerling's Elements of Mineralogy, II. 124. et seq. (or Kirwan, II. 324. N.)

‡ In the original the words are "M. de Reichenstein," which I suppose to be an oversight, and that I am correct in translating the words M. Muller de Reichenstein which occur a few lines before, on the supposition that M. Muller actually resides at Reichenstein, without deriving any titular name from that town. N.

apparatus,

apparatus, heat is gradually to be applied to ignition. In proportion as the oil becomes decompofed, brilliant metallic drops are obferved, fimilar to thofe in the diftillation of mercury, which line the upper part of the retort, and run down at intervals to the bottom of the veffel, immediately after which they are replaced by others. After the cooling, thefe metallic drops are found congealed, and adhering to the fides of the retort and the bottom of the veffel; and the reft of the metal, reduced in the form of a button with a brilliant furface, moft commonly prefenting a cryftallized face.

The effential Characters of this new Metal.

1. Its colour is white like tin, but inclining to a leaden grey. Its metallic fplendor is confiderable; its fracture lamellated (gerade blattrig). It is very brittle and friable, and by flow cooling it readily acquires a cryftallized furface.

2. Its fpecific gravity is 6,115.

3. It belongs to the clafs of the moft fufible metals.

4. Heated with the blow-pipe upon charcoal it burns with a flame confiderably brilliant, of a blue colour, but greenifh at the edges; it rifes totally in a grey whitifh fume, and emits a difagreeable fmell, which approaches that of radifhes. If the flame be withdrawn before the fmall portion fubjected to the heat is entirely volatilized, the remaining button preferves its fluid ftate for a long time, and, during the refrigeration, becomes covered with a radiated vegetation.

5. This metal amalgamates eafily with mercury.

6. With fulphur it forms a fulphuret of a leaden-grey colour, and radiated ftructure.

7. Its folution in the nitric acid is clear and colourlefs; when concentrated, it fpontaneoufly, in the courfe of time, affords fmall white and light cryftals in the form of needles, which poffefs the dendritic aggregation.

8. The new metal is likewife foluble in the nitro-muriatic acid: when a large quantity of water is added to a folution of this nature, the metal falls down in the ftate of oxide, in the form of a white powder, which in this ftate is foluble in the muriatic acid.

9. When a fmall quantity of this metal is mixed in the cold, with one hundred times its weight of concentrated fulphuric acid, in a clofed veffel, the fluid gradually affumes a beautiful crimfon red colour. By the addition of a fmall quantity of water, added drop by drop, the colour difappears, and the minute portion of metal which was diffolved falls down in the form of black flocks. Mere heat alfo deftroys this folution; it caufes the red colour to difappear, and difpofes the metal to feparate in the ftate of a white oxide.

10. When, on the contrary, the concentrated fulphuric acid is diluted with two or three parts of water, and a fmall quantity of nitric acid is added, this mixture diffolves a confiderable portion of the metal. The folution is clear and colourlefs, and is not decompofed by the mixture of a greater quantity of water.

11. All the pure alkalis precipitate from the acid folutions of this metal a white oxide, foluble in all the acids. The precipitate is entirely foluble by excefs of alkali. If a carbonate be ufed inftead of a pure alkali, the fame phenomenon takes place; with this difference, however, that by an excefs of the carbonate the precipitate which is formed is rediffolved in part only.

12. A very pure pruſſiate of potaſh occaſions no precipitate in the ſolutions of this metal. This is a remarkable exception to the general rule of metallic precipitations; which, however, it partakes with gold, platina, and antimony.

13. The alkaline ſulphurets, mixed with the acid ſolution, occaſion a brown or blackiſh precipitate, accordingly as the metal is combined with more or leſs of oxygen. It ſometimes happens that the colour of the precipitate perfectly reſembles kermes mineral, or the red ſulphurated oxide of antimony. When the ſulphuret of tellurium is expoſed on an ignited coal, the metal burns with a blue colour, together with the ſulphur.

14. The infuſion of the nut-gall, combined with the ſame ſolutions, affords a precipitate in flocks of an Iſabella colour.

15. Iron and zinc precipitate tellurium from its acid ſolutions in the metallic ſtate, under the form of ſmall black flocks, which reſume the metallic brilliancy when rubbed, and are fuſed into a metallic button upon an ignited coal.

16. Tin and antimony occaſion the ſame phenomenon with the acid ſolutions of the new metal. The precipitate formed by antimony proves, in the moſt ſtriking manner, that tellurium is not antimony diſguiſed, as had been ſuppoſed. The ſolution of tin in the muriatic acid, mixed with a ſolution of tellurium in the ſame acid, likewiſe produces a black metallic precipitate.

17. The oxides of tellurium, obtained from the acid ſolutions by alkalis, or from alkaline ſolutions by acids, are in either caſe reduced with a degree of rapidity approaching to detonation, by expoſure to heat upon charcoal. It burns, and is volatilized, as has already been mentioned.

18. By the application of heat, for a certain time, in a retort, this oxide of tellurium becomes fuſed, and, when cold, appears of a ſtraw colour, with a kind of radiated texture.

19. With the addition of any fat ſubſtance, the oxide of tellurium is perfectly reducible by the method before deſcribed.

The white ore of gold from *Fatzbay*, aurum vel metallum problematicum, contains, in 1000 parts, tellurium in the metallic ſtate, 925,5; iron, 72,0; gold, 2,5.

The graphic gold of Offenbanya contains, in 100 parts, tellurium in the metallic ſtate, 60; gold, 30; ſilver, 10.

The mineral known by the name of the yellow ore of Nagyag contains, in 100 parts, metallic tellurium, 45,0; gold, 27,0; lead, 19,5; ſilver, 8,5; and of ſulphur a minute portion.

The mineral known by the name of the grey foliated ore of gold from Nagyag contains, in 100 parts, lead, 50; metallic tellurium, 33; gold, 8,5; ſulphur, 7,5; ſilver and copper, 1.

After the above was printed in the Annales de Chimie, the editors of that excellent work received a tranſlation of a manuſcript addreſſed by M. Klaproth to Cit. Van Mons, on their behalf. From this they extracted the following mineralogical and chemical details *:

The colour of the metallum paradoxum, of the mine of Fatzbay, is between the white of tin and the grey of lead: it has much metallic brilliancy. It is ſometimes in lumps, and then forms an aggregate of cryſtalline grains. Its texture is uſually fine or ſmall grained.

* Annales de Chimie, xxv. 327.

Its

Its matrix is composed of quartz and marl. The subject of the first analysis was taken from a piece of the compact variety detached in 1780.

The graphic gold of the mine Franciscus at Offenbanya, forming the second variety, is of the white colour of tin, partly inclining to the yellow of brass: it is very brilliant, composed of prismatic crystals, flat and compressed, of which the mutual position affects the form of the characters of Turkish writing, which has given rise to its empyrical name. It is usually found between the greyish blue argillaceous porphyry, bedded in grey quartz. The proportion of the constituent parts of this ore vary much: the middle term has been taken.

The third variety, called the yellow ore of gold, is of a white silver colour inclining to the yellow of brass, compact, and interspersed with quartz and brown spar. It is not known whether that specimen which presents radiations of considerable magnitude, and exhibits a lamellated texture and fracture, is of the same species: it is found in a mixture of quartz crystals, and brown red spar, and sometimes in the foliated ore.

The foliated ore, or grey foliated gold ore of Nagyag, differs, in its chemical and mineralogical characters, from the three foregoing, which are comprised under the name of white gold ores; which has caused it to be admitted, in the new system of mineralogy, as a particular species of the genus Gold. Its colour is a deep leaden grey, inclining to the iron black. It is seldom found compact, but most commonly inserted in the form of small united leaves, and likewise in thin, oblong, hexahedral tables, partly accumulated in cavities. Its metallic splendor is but moderate: its fracture most commonly exhibits contorted leaves; it is speckled, and in some specimens the leaves are slightly flexible. Its matrix is composed of quartz mixed with reddish manganese, which it has penetrated in every direction.

Scopoli, Sage, and Ruprecht, attempted to analyse this ore; but the difference of their results rendered their experiments very uncertain. They had clearly ascertained the presence of a substance volatile by heat; but they were deceived in taking it sometimes for arsenic, and in other instances for antimony.

It is to M. Von Muller, at present director of the mines at Zalathna, that M. Klaproth ascribes the honour of having first observed this new metal (in the collection of Memoirs of the United Friends of Vienna, published by Born). He expresses his acknowledgment for the specimens he sent to him, which enabled him to prove its existence. He does not omit the observation, that Bergman, though he durst not decide concerning the true character of this metallic substance, did nevertheless declare that it was not antimony.

We have seen, in the foregoing abstract, (p. 372, No. 3.) that the precipitate which is not re-dissolved by ammoniac is a mixture of gold and iron. There are, doubtless, several methods of separating these two metals; but, perhaps, it may be satisfactory to know the method which was used by M. Klaproth. He re-dissolved the whole in the nitro-muriatic acid, and precipitated the gold by a solution of the nitrate of mercury made without heat, which he poured gradually into the former solution, till the precipitate which fell down had changed its brown colour for white. The precipitate, being carefully collected, was reduced into pure gold.

"I shall give," says M. Klaproth, "in the third volume of my *Beytraege*, &c. the particulars of these analyses of the gold ores of Transylvania which contain tellurium, after

after having once more repeated them, in order to determine the proportions with more certainty and precifion. The refearches of mineralogifts and chemifts will foon inform us whether tellurium is likewife met with in other places, or whether ature has exclufively appropriated this metal to the gold mines of Tranfylvania.

SCIENTIFIC NEWS, AND ACCOUNT OF BOOKS.

American News.

IN confideration of the general utility that would refult from the citizens of the United States being enabled to procure, free from expence, an analyfis of any ores, or mineral fubftances, "The Chemical Society of Philadelphia," on the 20th of June 1797, paffed the following Refolution:

"Refolved,

"That a Committee of five Members be appointed, whofe bufinefs it fhall be to notify in the different papers of the United States, and by circular letters, that they will give an analyfis of all minerals which may be fent them."

In conformity to the above refolution, they have given notice that they will analyze any mineral which may be fent them, provided it be forwarded free of expence, and accompanied with an account of the place and fituation in which it was found.

Committee.

Thomas Smith, No. 19, North Fifth Street.
James Woodhoufe, No. 13, Cherry Street.
Samuel Cooper, No. 178, South Front Street.
Adam Seybert, No. 191, North Second Street.
John C. Otto, No. 37, North Fourth Street.

Profeffor Barton of Philadelphia, who has lately publifhed a fmall tract on the Vegetable Materia Medica of our country, is preparing for the prefs a work to be entitled "Strictures on the Arrangement of the Materia Medica, adopted by Dr. Darwin in his Zoonomia."

January 19, 1798. The *American Philofophical Society* held their annual election of officers on the firft Friday of this inftant, when the following were duly chofen:

President—The Hon. Thomas Jefferfon.
Vice-Prefidents—Nicholas Collin, D. D. Dr. Benjamin Rufh, and Dr. Cafpar Wiftar.
Treafurer—Mr. John Vaughan.
Secretaries—Samuel Magaw, D. D. Dr. Adam Seybert, Dr. J. C. James, and Mr. Samuel H. Smith.
Curators—Mr. Charles W. Peale, Dr. Benjamin S. Barton, and Mr. Robert Patterfon.
Clafs of Counfellors for three years—Mr. Jonathan B. Smith, Dr. William Currie, William Smith, D. D. and Mr. Jonathan Williams, two years from January 1798.

Aerostation.

AEROSTATION.—*August* 12, 1798.

BLANCHARD aſcended into the atmoſphere, for the forty-ſixth time, by means of an apparatus conſiſting of five balloons attached to a car, and a ſixth ſmall globe. He threw out a dog attached to a parachute, which deſcended gradually, but of whoſe fate no mention is made in the Moniteur, whence I extract this intelligence. He roſe at half paſt noon from Rouen, aſcended to the height of 2500 toiſes, and landed again at 55 minutes after two, near the village of Bazancourt, 12 leagues diſtant from the firſt place. We have no account of any remarkable obſervation made during this voyage, nor the reaſons why his apparatus was ſo complicated.

Cit. Garnerin, on the 28th of the ſame month, made his eleventh aſcenſion from Paris. His courſe for a conſiderable time was near the ground, during which he converſed with the people below. Theſe converſations ſhewed how much the earth reflected ſound; for all his words were repeated five or ſix times. He thought at firſt that it might be governed by ſome local circumſtances, which indeed is very probable with regard to the repetition. He deſcended ſeveral times to the ſame level, at diſtances of ten leagues aſunder, where he conſtantly obſerved the ſame effect. This great vibration of the air was not ſenſible to diſtances exceeding 150 or 200 toiſes. It decreaſes with the diſtance.

Does the vertical tranſmiſſion of ſound differ from that which is made in an horizontal direction? On this head, however, may be read the very entertaining account of David Frœdlichius, at the end of the 19th chapter of the firſt book of Varenius, who aſcended the higheſt eminences of Carpathas, near Keſmarkt, in Hungary. It is copied by Derham, in the firſt volume of his Phyſico-Theology.

This aëronaut was accompanied by a female Citizen, Henry. They roſe at 25 minutes after four, and deſcended at nine in the evening, at the gates of Chalons, forty leagues from Paris, and thirty-ſeven from the place whence they departed.

Eſſays Political, Economical, and Philoſophical, by Benjamin Count of Rumford. Eſſays VIII. and IX.

THESE two Eſſays have been before publiſhed in the Philoſophical Tranſactions; the one as long ago as the years 1786 and 1792, and the other in 1798. As this laſt is inſerted in our Journal, Vol. II. p. 106, it will be unneceſſary to inſert its contents in this place. Both will be highly acceptable to the poſſeſſors of the other Eſſays of the Count, to complete the collection of which theſe were wanted.

The contents of the eighth Eſſay are, Chap. I. An Account of the Inſtruments that were prepared for making the propoſed Experiments. A Thermometer conſtructed, whoſe bulb is ſurrounded by a Torricellian Vacuum. Heat is found to paſs in a Torricellian Vacuum with greater difficulty than in Air. Relative conducting Powers of a Torricellian Vacuum and of Air with regard to Heat, determined by Experiment. Relative conducting Powers of dry Air and of moiſt Air. Relative conducting Powers of Air of different degrees of Denſity. Relative conducting Powers of Mercury, Water, Air, and a Torricellian Vacuum.—Chap. II. The relative Warmth of various Subſtances uſed in making Artificial Clothing, determined by Experiment. Relative Warmth of Coverings of the ſame Thickneſs,

nefs, and formed of the fame Subftance, but of different Denfities. Relative Warmth of Coverings formed of equal Quantities of the fame Subftance, difpofed in different ways. Experiments made with a view to determining how far the Power which certain Bodies poffefs of confining Heat depends on their Chemical Properties. Experiments with Charcoal, with Lamp-black, with Wood-afhes. Striking Experiments with Semen Lycopodii. All thefe Experiments indicate that the Air, which occupies the Interftices of Subftances ufed in forming Coverings for confining Heat, acts a very important part in that operation. Thofe Subftances appear to prevent the Air from conducting the Heat. An Enquiry concerning the Manner in which this is effected. This Enquiry leads to a decifive Experiment, from the refult of which it appears that Air is a perfect Non-conductor of Heat. This Difcovery affords the means of explaining a Variety of interefting Phenomena in the Œconomy of Nature.

Traité de la Sphere et du Calendrier, par Rivard, 5me Edition, revue et augmentée par Jérôme Lalande, 1 vol. 8vo. avec Gravures, à Paris. A Treatife on the Sphere and the Calendar, by Rivard, revifed and augmented by Jerome Lalande, 1 vol. 8vo. with Plates.

THE modern advances in Aftronomy rend ered it neceffary to make fome alterations in this Work, which poffeffes a high character for Perfpicuity and Accuracy. Cit. Lalande has corrected the Table of Latitudes and Longitudes, and added a Chapter on Time, befides making other Improvements.

Philofophy of Mineralogy. By Robert Townfon, LL.D. F.R.S. Edin. 8vo, 219 pages, with three Engravings.

THIS performance is the outline of a larger work formerly announced, and intended to have been accompanied by a collection of foffils, but which did not meet with the expected fupport. It confifts of twelve chapters. The three firft contain an introduction, with an account of the fimple elementary fubftances of which minerals are compofed, and the laws of aggregation and combination by which they are governed. Thefe are followed by an enumeration of compounds, according to Dr. Babington's excellent "Syftematic Arrangement," and four chapters refpectively treating upon Stratification, the Irregularities of the Earth's Surface, Veins, and Petrifactions. The Author then proceeds to confider the value and ufe of the external characters of Minerals ; and gives a very ample terminology, confifting of the appellations in Englifh, Latin, and German, with their correfpondent definitions, under the titles of Colour, Figure, Surface, Luftre, Texture, Structure, Fracture, and Fragments ; Tranfparency, Scratch, Score, and Soiling ; Cohefion, Adhefion, Sound, Feel, Coldnefs, Denfity, Smell, Tafte, and Friability : To which he adds the Habitudes, or Refults of Experiment. Two fubfequent chapters indicate the ufe of thefe terms in Claffification, Defcription, and Inveftigation ; with fhort Inftructions for collecting Specimens, and forming Cabinets. The concluding chapter contains a lift of near three hundred works on Mineralogy.

Proceedings of the Aſſociation for promoting the Diſcovery in the Interior Parts of Africa, &c.

Abſtract of Mr. Park's Travels. [Concluded from page 332.]

AFTER travelling upwards of a month, aſcending by the ſide of the Niger till it ceaſed to be navigable, he at length ſunk under his fatigues, and the difficulties of his enterpriſe; and at Kamalia, five hundred miles ſhort of any friendly country, on the Gambia, he fell into a ſevere and dangerous fit of ſickneſs. If in this ſituation had he been able to travel, great part of his way lay through a deſert. He had therefore no other reſource but to wait for the firſt caravan of ſlaves which might travel the ſame track. Such a one was expected to paſs through Kamalia at the end of three months, and the chief director reſided at the place. To him, therefore, Mr. Park applied; and for the value of one ſlave, to be paid on his ſafe arrival at the Gambia, this worthy negro, whoſe name was Karfa Taura, not only undertook to conduct him ſafe to Piſania, but offered him likewiſe the accommodation of his houſe until the time of the caravan's departure. Under this man's roof our traveller was confined to his mat (his only bed), by a ſevere and dangerous fever, for upwards of a month. Five months longer was he detained for the caravan. During this long interval, not a murmur eſcaped the lips of Karfa, nor of any of his wives, at the trouble and expence which their inmate brought upon them. To the kind attentions, the tender ſolicitude, the cheerful aſſiduity, and flowing hoſpitality, of theſe poor Pagans, Mr. Park declares that he is indebted, not only for his ſafe return to Great Britain, but alſo for the preſervation of his life; and he admits that he made his friend Karfa but an inadequate return (though the beſt in his power), by preſenting him, on their arrival at the Gambia, with double the ſum that he had originally promiſed.

During this long confinement of Mr. Park, he acquired much information reſpecting the trade in ſlaves and gold-duſt, the vegetable productions of Africa, the character of the natives, their agriculture and manufactures, their modes of living, manners, ſuperſtitions, wars, police, and government, which have never yet been competently deſcribed, and for which we muſt wait for the appearance of his work. In the mean time it may be remarked, that though the climate on the borders of the deſert is prodigiouſly hot, yet in the ſouthern diſtricts, which abound with wood and water, the climate improves, and in the mornings and evenings the air is ſerene, temperate and pleaſant. Some of the vegetable products have been noticed. To theſe may be added the Lotus, of ancient renown, affording a ſmall, yellow, farinaceous berry about the ſize of an olive, which being pounded in a wooden veſſel, and afterwards dried in the ſun, is made into excellent cakes reſembling the ſweeteſt gingerbread. Moſt of the edible roots of the Weſt Indies are likewiſe found here, together with indigo, cotton and tobacco; but neither the ſugar cane, coffee, cacao, the pine-apple, nor a variety of other fruits, were ſeen by him, nor known to the natives. Uncultivated lands belong to the ſtate; but in other reſpects landed property is admitted, without, as it ſhould appear, any particular feodal or other limitations. Among their manufactures may be reckoned, an excellent beer made from corn; the fabrics of cotton cloth, which are dyed with indigo; the tanning of leather, which is ſtained both yellow and red; the ſmelting of iron, though imperfectly; and the caſting and working of gold.

From

From the conduct and cruelty of the wars between the petty and independent ſtates of Africa, it appears that thoſe who do not make ſlaves of their captives put them to death. With regard to religion, the Mahometans ſhew much zeal in teaching the Negro children to read, and avail themſelves of this means to convert them from Paganiſm. Circumciſion, which is notoriouſly more ancient and extenſive in its prevalence than the religion of Mahomet, is practiſed alſo by the Negroes, who conſider it rather as an operation of phyſical than religious neceſſity. The conviction of a future ſtate of rewards and puniſhments was univerſally prevalent in every diſtrict viſited by our traveller.

In the latter end of April 1797, the caravan being completed, and Mr. Park's health perfectly re-eſtabliſhed, he ſet out from Kamalia, in company with ſeventy perſons, of whom thirty-ſeven only were ſlaves for ſale. On the 4th of June they fell in with the river Gambia; and in ſix days more, namely on the 10th, Mr. Park had the ſatisfaction to enter the houſe of Dr. Laidley, from which he had ſet out eighteen months before. On the 15th of the ſame month, he embarked in a ſlave-ſhip for America; which being driven by ſtreſs of weather into the iſland of Antigua, Mr. Park took his paſſage from thence in a veſſel bound to Great Britain, and on the 25th of December arrived ſafely in London.

*** The reſpectable Writer of a Paper on the Secondary Foci of Lenſes, is informed, that a bad ſort of concave Reflectors has long ſince been conſtructed and ſold in London by ſilvering one ſurface of a convex lens; and that it is probable theſe foci (which are eaſily determined from the curvatures and refractive powers) may have been neglected by optical writers, becauſe the images are in every caſe more dilute and indiſtinct than ſuch as are produced either by refraction, or reflection alone. That the effect has not been diſregarded as a ſource of imperfection in lenſes, may be ſeen by conſulting our Journal, II. 233.

Mr. John Priors improved Escapement.

Fig. 2.

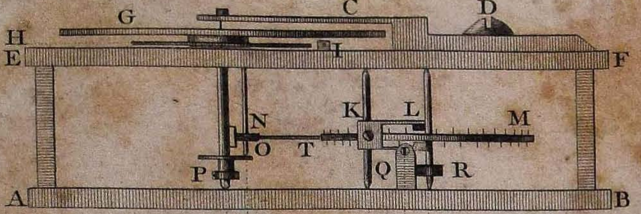


Fig. 1.

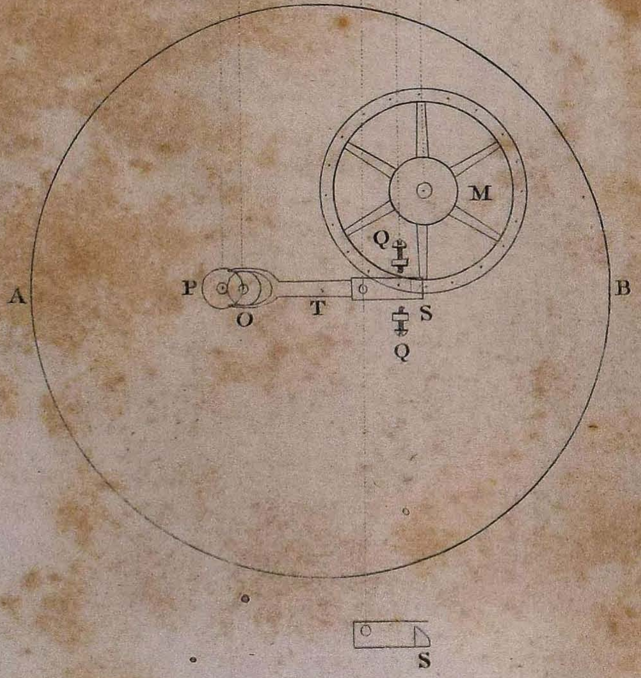
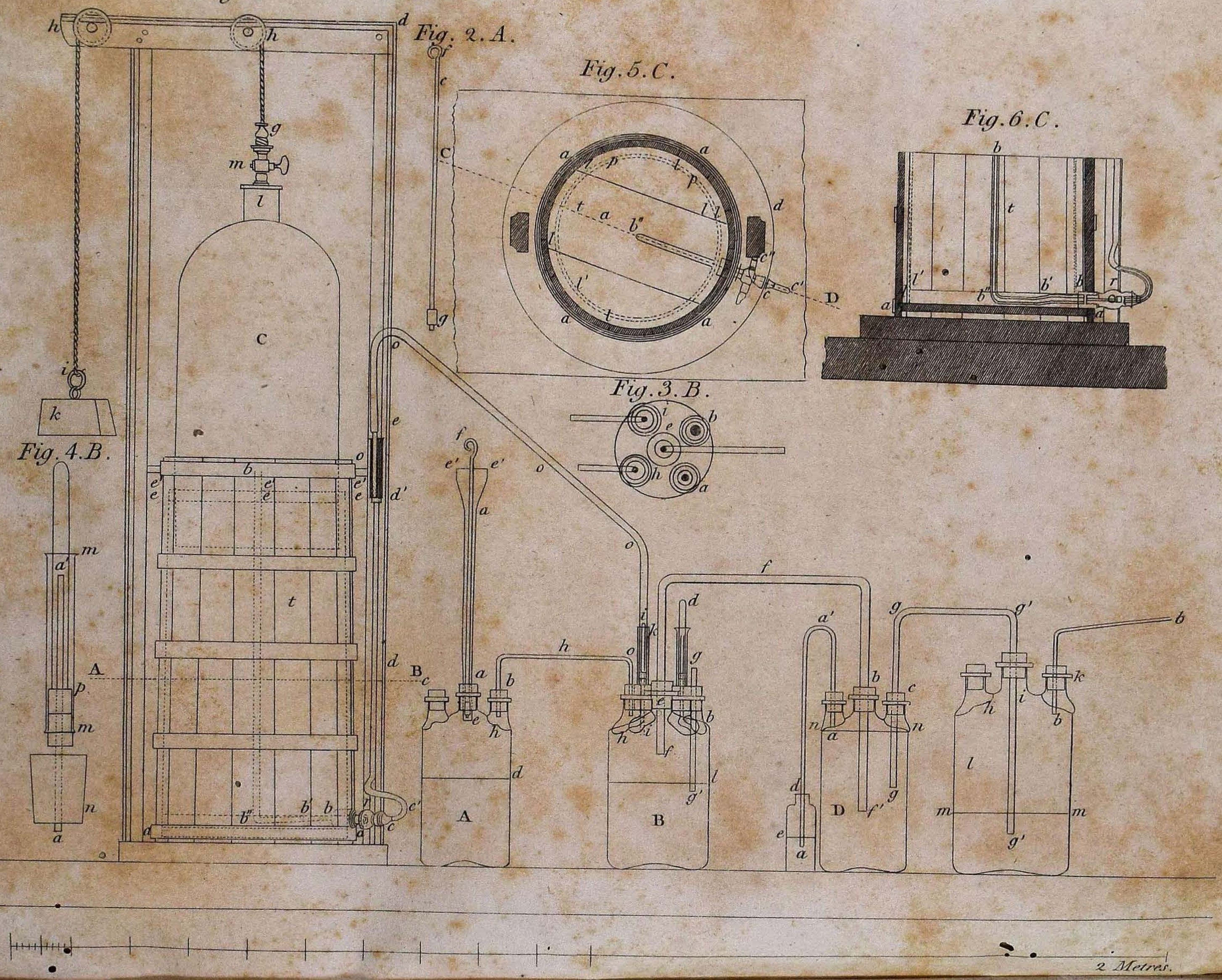


Fig. 3.

Barlow sculp.

Apparatus for the saturation of Carbonate of Potash.